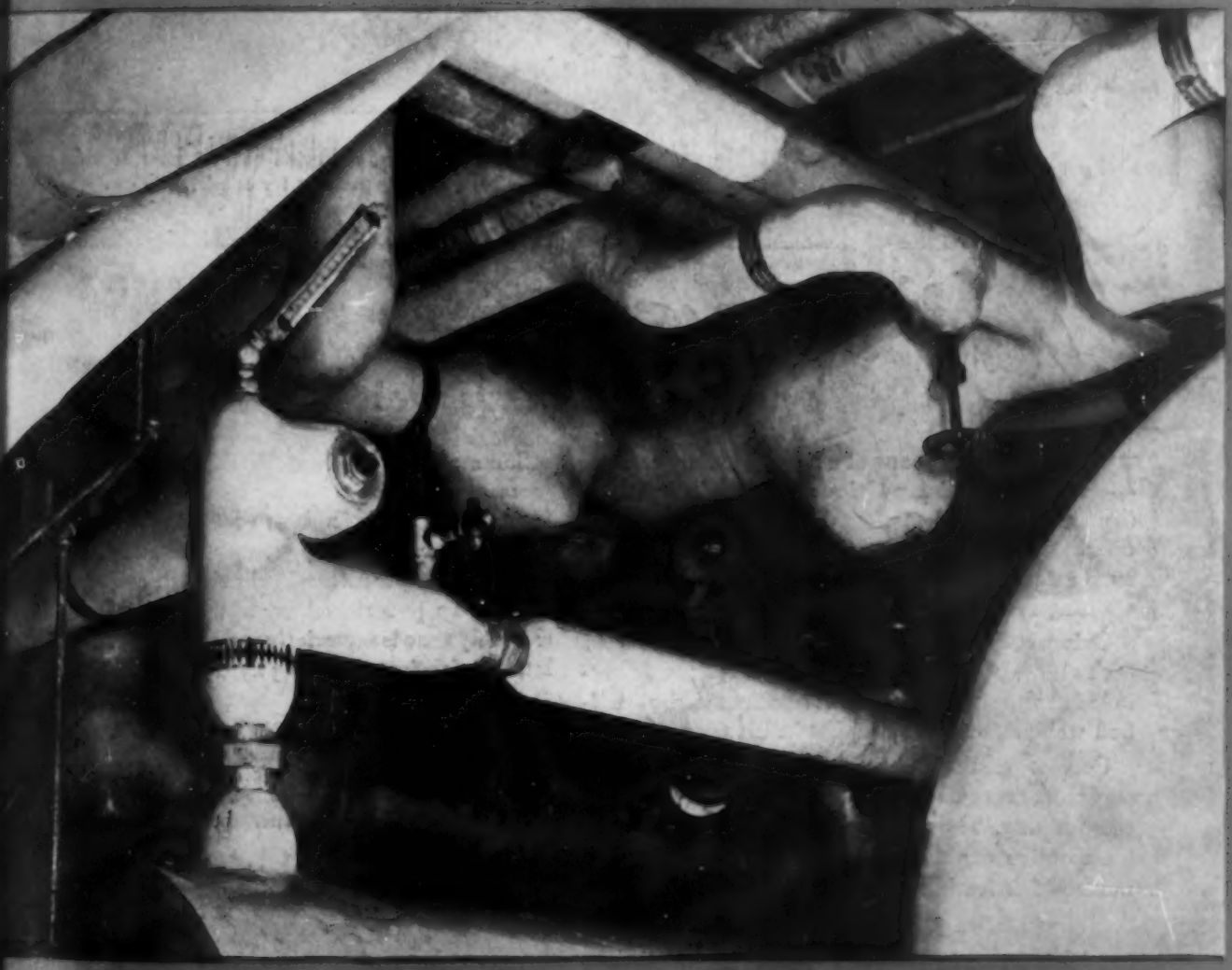
Heating Piping & Air Conditioning

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

JULY ★ 1947

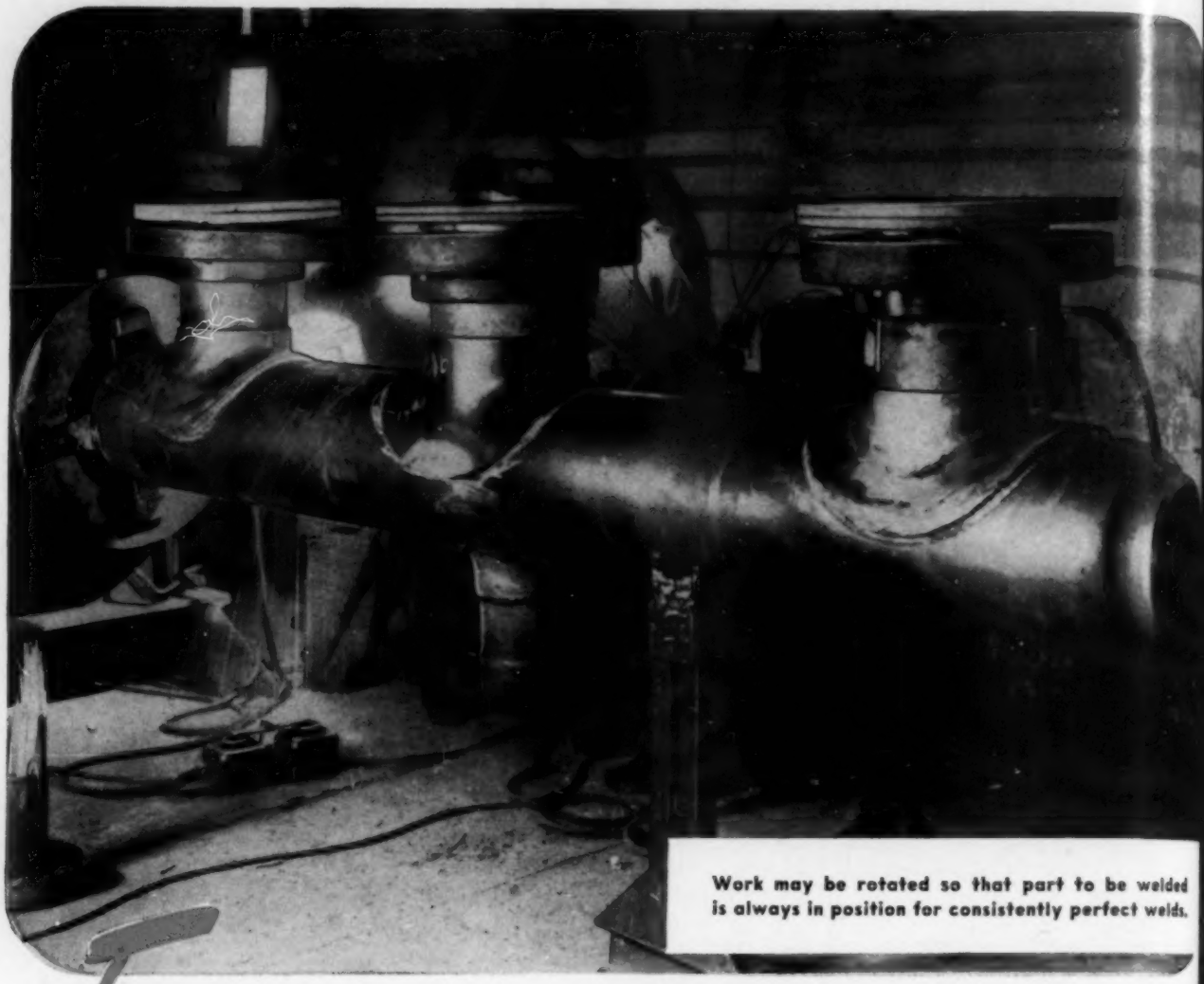
DESIGN
INSTALLATION
OPERATION
MAINTENANCE

101 — Journal Section of the American Society of Heating and Ventilating Engineers



Identification of piping by some such scheme as that used by Marshall Field & Co. (page 81) aids operation

CONTENTS . . PAGE 67



Work may be rotated so that part to be welded is always in position for consistently perfect welds.

EVERY SIDE IS UP

with this rotating welding fixture . . .

HERE IS GRAPHIC PROOF of one of the many reasons why the welds on Grinnell Prefabricated Piping are clean and flawless. With roll welding the operator can work to better advantage because the most accessible welding position is maintained. Also welding bead can be cleaned during rotation.

Grinnell shops are equipped with hundreds of such aids to better welding—jigs, turntables, adjustable fixtures and positioners . . . all manned by qualified welders, each a *specialist* in his type of work.

Correct welding is but one of many reasons why engineers everywhere rely on Grinnell for prefabricated piping. They know they can be sure of expert interpretive engineering and laboratory research, modern fabricating facilities and rigid inspection.

Summed up, Grinnell Prefabricated Piping assures *quality* and *economy* because of one source for design and fabrication; pretesting and approval before shipment; only completed assemblies are billed and at predetermined prices; delivery schedule can be predetermined but kept flexible; field assembly time is materially reduced. Write for booklet, "Prefabricated Piping by Grinnell".

GRINNELL COMPANY, INC.
Executive Offices, Providence 1, R. I.

Pipe Fabrication Plants
Cranston, R. I. • Atlanta, Ga. • Warren, Ohio

Branches and Warehouses

Atlanta 2, Ga.	Kansas City 16, Mo.	Philadelphia 34, Pa.
Charlotte 1, N. C.	Los Angeles 13, Cal.	Sacramento 14, Cal.
Chicago 9, Ill.	Milwaukee 3, Wis.	St. Louis 10, Mo.
Cleveland 14, O.	Minneapolis 15, Minn.	St. Paul, Minn.
Cranston 7, R. I.	New York 17, N. Y.	San Francisco 7, Cal.
Houston 1, Tex.	Oakland 7, Cal.	Seattle 1, Wash.

GRINNELL

WHENEVER PIPING IS INVOLVED

Heating Piping & Air Conditioning

With which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

Board of Consulting and Contributing Editors . . .

A. R. Bernz, Leo F. Collins, Sabin Crocker, R. C. Doremus, Philip Drinker, Walter L. Fleisher, F. E. Giesecke, William Goodman, William A. Hanley, J. J. Harman, R. S. Hawley, E. P. Heckel, R. E. Hieronymus, J. C. Hornung, John Howatt, Lee P. Hynes, C. W. Kimball, Dwight D. Kimball, A. C. Kirkwood, Charles S. Leopold, Samuel R. Lewis, H. C. Murphy, Alfred J. Offner, F. B. Rowley, Robert P. Schoenljahn, Kalman Steiner, T. S. Tenney, Rush D. Touton, Eph. A. Tyler, W. H. Wilson.

Editor.....C. M. Burnam, Jr.

Associate Editor.....Thomas V. Johnson

Advertising Staff . . .

Wallace J. Osborn
New York
Telephone: Murray Hill 9-8293

Robert A. Jack
Cleveland
Telephone: Yellowstone 1540

James D. Thomas
Chicago
Telephone: State 6916

George C. Cutler
Chicago
Telephone: State 6916

R. P. Wettstein
Los Angeles
Telephone: Tucker 2779
San Francisco
Telephone: Douglas 4475

Ralph M. Jepson
Detroit
Telephone: Townsend 85189

Publisher.....Frank P. Keeney

Manager.....Charles E. Price

Production Manager....Lawrence A. Doyle

Published monthly by the Keeney Publishing Co., 6 North Michigan Avenue, Chicago 2, Illinois. Telephone: State 6916. Subscriptions: U.S. and possessions, Canada, Mexico, Central America, South America, $3.00 per year; other, $6.00. Current copies, U.S. and possessions, 35c each, back copies, 50c each. January 1947 issue, $1.00 per copy. Member Audit Bureau of Circulations and Associated Business Papers, Inc.

Copyright 1947 by the Keeney Publishing Co.

CONTENTS THIS MONTH

Vol. 19 JULY 1947 No. 7

The Editor's Pages (news, notes, and comment) 63

Practical Pointers on Radiant Heating Design, by R. G. Vanderweil 69

Unit Heater and Fan Solve a Launderette Comfort Problem 71

Graphitization of Piping 72

Retractable Ice Rink Used in Night Club 75

Planning to Air Condition? 76

Unique System Serves Heating Distributors 78

85-Below-Zero Refrigeration System Being Installed at Kodak Park 80

Summarizes Fuel Oil Outlook 80

Identifying Piping Systems 81

Clean Your Ducts for Better Results!, by George L. Candler 83

Antifreeze Protects Cooling Coils, by W. E. Lowell 85

Sam Lewis' Page—"Lazy" Zoning Causes Heating, Cooling Troubles 86

Changes in NFPA Standards for Air Conditioning Reconsidered .. 87

Pipe Welding, Business Outlook (HPACCNA Meeting) 88

New Heat Transfer Data from Wartime Studies 91

Refrigerating Engineers Hear Two Talks on Panel Cooling 92

New Candy Plant Air Conditioned 94

"Open for Discussion" 95

Data Sheet—Simplified Procedure for Specification Writing 97

Question of the Month 100

Equipment Developments 177

New Books & Reports 197

Meetings & Conventions 206

Recent Trade Literature 208

Index to Advertisers 224

Journal Section of the American Society of Heating and Ventilating Engineers

Physiological Adjustments of Human Beings to Sudden Change in Environment, by Nathaniel Glickman, Tohru Inouye, S. E. Telser, R. W. Keeton, F. K. Hick, and M. K. Fahnestock 101

Climate and the Energy of Nations (book review by Cyril Tasker) 115

Determination of Outside Design Temperatures—A Suggested Approach, by W. L. Holladay 117

Comfort Standards Feature Semi-Annual Meeting Discussion 123

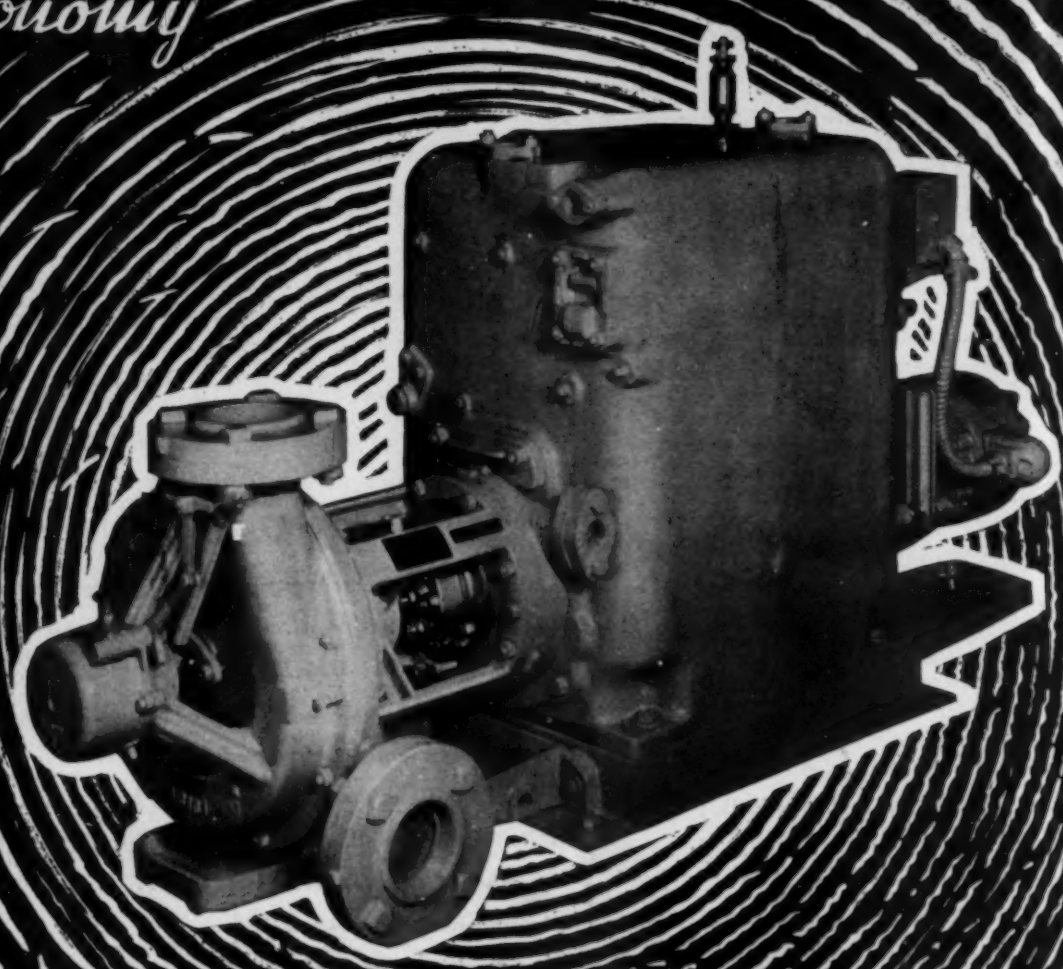
Summary of Local Chapter Meetings 126

Candidates for Membership 132

Candidates Elected 134

Officers, Council, and Committees 135

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

R. G. Vanderweil Explains Confusion of Different Methods, Tells How to Arrive at Common Basis for Design

Practical Pointers On RADIANT HEATING DESIGN

ANYONE ATTEMPTING to design adiant heating systems with the d of available literature will soon nd himself bewildered by contra- ctory statements. That many en- ineers actually are confused has en brought out repeatedly in ra- iant heating forums and open dis- ssions attended by the author. It ems worthwhile to point out some the more important contradic- ry statements and to re-state the sic principles inherent in all roper methods of design.

The Perplexed Heating Designer

Let us see how, as beginners, we uld go about designing a radiant eating system. First, we might tempt to collect all published in- rmation relating to the subject. his would result in a large accu- ulation of material, much of hich is devoted to unessential de- ils and most of which can be filed ay for later reference if re- ired.

The few books and articles con- rned with factual design data should be studied carefully. We would find some mathematical papers published by colleges and research foundations which we should read and digest—that is, if we are still in command of our college math. Some of us might want to rely on less complicated representations which have been worked out by authors thoroughly familiar with the mathematical papers and which are based on these papers. If we confined ourselves to such literature and filed away all other, we would be surprised to find that out of our immense first collection of papers we would have left just a few pamphlets which could be filed in one desk drawer.

We would also discover some physical principles common to all design methods which would result in simple statements such as: "The heat output of an embedded coil of given dimensions (tube, OD, center line, spacing, etc.) and given water temperature remains the same no matter what type of metal is used for tubing"; or, "Satisfactory comfort may be had with any type of control system that maintains the room air temperature constant within, say, a degree or two, and which may be regulated up or down according to the occupants' desire"; or, "No control equipment is available to predict sunshine and fully compensate the sun's heating effect."

Of course, many similar minor statements may be made, but let us look now into the major design problems, the discrepancies found with the various methods, and their common base.

Panel Heat Output

It may seem surprising to find in the literature that the recommended floor panel output varies from about 40 to 100 Btu per sq ft per hr. This should be less surprising if we consider that the output of a heated surface to the associated space varies not only with its surface temperature but also with the air, wall, and glass temperature of the space. The greater the temperature difference between

THAT MANY ENGINEERS are confused by contradictory statements on the design of radiant heating systems has been brought out at many forums and open discussions on this subject. Mr. Vanderweil, project engineer, Chase Brass & Copper Co., explains here the "why" of some of these contradictions and points the way to a common basis for design of this type of system

panel and air and between panel and unheated surfaces, the greater the panel output. This indicates that we can obtain greater panel output by two means:

a) By increasing the panel surface temperature (say from 80 to 85 F).
b) By decreasing the room's surface temperatures or, in more practical words, by delivering heat to rooms of large glass area and uninsulated walls.

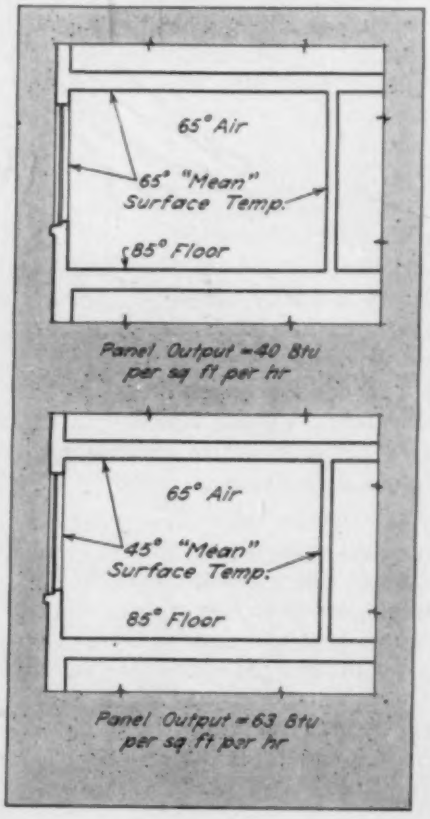
Reiterating point (a), it should be stated first that by no means is it possible to guarantee a 100 Btu per sq ft floor output with a panel temperature of 85 F in a room designed for 70 F. This is true even in an "all glass" room; and let it be said right here that an 85 F surface temperature seems the only figure the experts will agree upon when discussing floor panel design. Higher temperature, it is said, may bring complaints regarding "warm feet," etc.

But (you will ask) what values shall we use when designing our system? Due to lack of standards we must use our general engineering knowledge and common sense to answer this question. We know that for a *given* room, the heat output varies with the floor temperature. We also know that high floor temperatures are adverse to comfort (particularly in continuously occupied spaces), and if we happen to be of a conservative nature, we would decide on the minimum recommended value of 40 Btu per sq ft per hr. If we were less conservative, we might use a 50 Btu, or slightly higher, output and excuse this by the following argument: Although a floor temperature higher than 85 F should not be tolerated throughout the heating season, a system that operates with maximum floor surface temperature only at 0 F outside temperature will exceed 85 F only during relatively few hours per year.

If our space is not designed for continuous occupancy, we might select even higher values, possibly 60 Btu per sq ft, but we should then be aware of the fact that our mean floor temperature would exceed 85 F even at medium outside temperatures—that is, if the room's heat losses are identical with those computed according to the ASHVE's Heating, Ventilating, Air Conditioning Guide. In a bathroom, for instance, or a corridor such conditions may be allowed.

Considering point (b), we remember that the floor output increases considerably in high industrial buildings or spaces of large glass area and even more in spaces where design temperatures are lower than 70 F. Let us keep in mind that the panel output is approximately proportional to the temperature difference between panel and room, and that by decreasing the design temperature from 70 to 60 F we can increase the output of an 85 F floor panel by approximately 50 per cent.

The temperature of the unheated surfaces in a room influences the heat output of a radiant heating panel. Both floor and ceiling panel outputs are greatly influenced by the unheated mean radiant temperature (MRT)


65° Air
65° "Mean" Surface Temp.
85° Floor
Panel Output = 40 Btu per sq ft per hr
65° Air
45° "Mean" Surface Temp.
85° Floor
Panel Output = 63 Btu per sq ft per hr

As another example, the output of a given 85 F floor panel to a space at 65 F air and wall temperature is 40 Btu per sq ft per hr, but to a space with 65 F air and 45 F mean wall, ceiling, and glass temperature it is 63 Btu if computed according to one and the same method. In spite of constant air temperature, the output has increased over 50 per cent.

So, if we had to design for lower room temperature for an industrial building or similar space, we would find the most conservative recommendation to be greater, say 55 Btu per sq ft, and we may select, 55, 65, or even 70—depending on type and period of occupancy of the space (and upon our grade of conservatism).

We see, then, that we have come to conclusions in spite of the contradictory data we had to use, merely by considering the essentials: For best comfort conditions, use lowest heat output. For continuous occupancy, use lowest heat output. Where room heat losses call for excessive floor outputs, use ceiling systems or additional wall panels.

Less confusing are the data on ceiling heat output. There we may assume that the ceiling surface temperature can be increased as the ceiling height increases. Very conservatively, the recommended maximum is as follows:

CEILING HEIGHT Feet	MAXIMUM OUTPUT Btu Per Sq Ft Per Hr
7	55
8	70
9	90
10	110

Here again we may want to select outputs 5 to 15 Btu greater than those recommended in the table. In gypsum ceilings the maximum allowable water temperature should be considered in addition to surface temperatures. Higher temperatures may cause calcination of the plaster, and the maximum allowable water temperatures are still subject to debate. It has been found in many installations that a design mean water temperature of 150 F (water inlet 165, outlet 135) gives satisfactory results. The reason for this may be found in the fact that maximum temperatures are used only with minimum outside temperatures and that the water temperature decreases rapidly as the outside temperature in-

creases. Hence, the average mean water temperature is considerably lower than the 150 F design mean temperature and very likely in the neighborhood of 110 F. Also, a thin calcine cover seems to form around the tube circumference and possibly protects the panel proper from further calcination.

Reviewing our progress up to this point, we find that, although it was difficult at first to reconcile the varied published data on panel output, we are able to select values that seem reliable and satisfactory for most conditions. Obviously, we should collect all possible information from typical existing installations before we decide on final design.

[Mr. Vanderweil will continue this practical discussion in a second article.]

Unit Heater and Fan Solve a Launderette Comfort Problem

YEAR 'ROUND comfort for patrons of a Bendix home launderette in Toledo, Ohio, has been achieved with a two-speed self-cooled motor propeller fan and a unit heater.

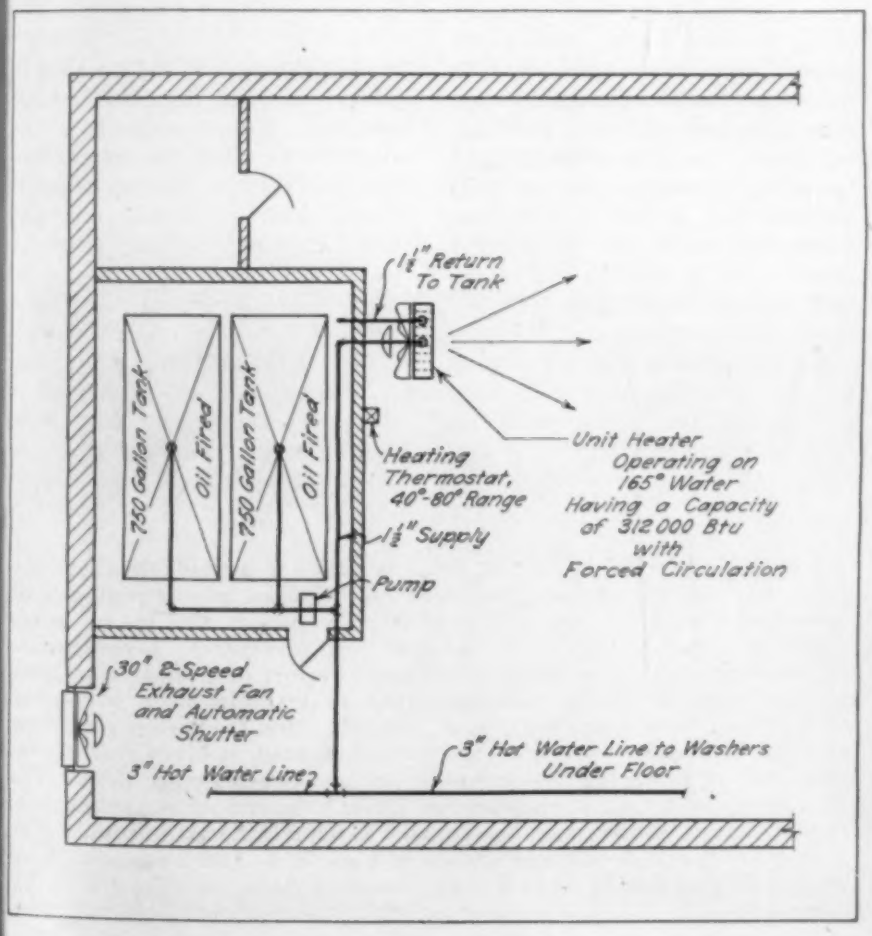
Heat given off by the washers created a problem in the summertime. This was solved by installing a fan with an automatic shutter to provide a 3 min air change in hot weather, inducing a breeze through the building and removing heat, steam, and soap odors. The fan is run at low speed on colder days.

The same hot water storage tanks and circulating pump supplying the washers also provide hot water for the unit heater. Since the laundering operation gives off some heat, only one large unit heater was necessary to maintain temperature within the building at 72 F.

Installed during the spring of 1946, the ventilating and heating units have been tested during extreme heat and cold waves, as well as during milder weather in between. The management of the launderette has expressed satisfaction with the comfortable air conditions, as well as the economy and simplicity of the installation and low operating costs.

The heating of the room is based on the use of 165 F water with pump circulation through a hot water unit heater. The heat radiated by the washers will raise the temperature of the store from 40 to 72 F; therefore the unit heater had to be sufficiently large to raise the temperature in the store to 40 F when it is zero outside.

Left—The unit heater is supplied with 165 F water from the same hot water storage tanks supplying the washers, as described in the text by C. G. Summers, manager of the Toledo branch office of Ilg Electric Ventilating Co. Right—The unit heater has capacity to raise the temperature to 40 F when it is zero outside, as the washers give off enough heat to raise the temperature of the store from 40 to 72 F


1½" Return To Tank
750 Gallon Tank
Oil Fired
750 Gallon Tank
Oil Fired
Heating Thermostat, 40°-80° Range
Unit Heater Operating on 165° Water Having a Capacity of 312 000 Btu with Forced Circulation
1½" Supply
Pump
30" 2-Speed Exhaust Fan and Automatic Shutter
3" Hot Water Line
3" Hot Water Line to Washers Under Floor

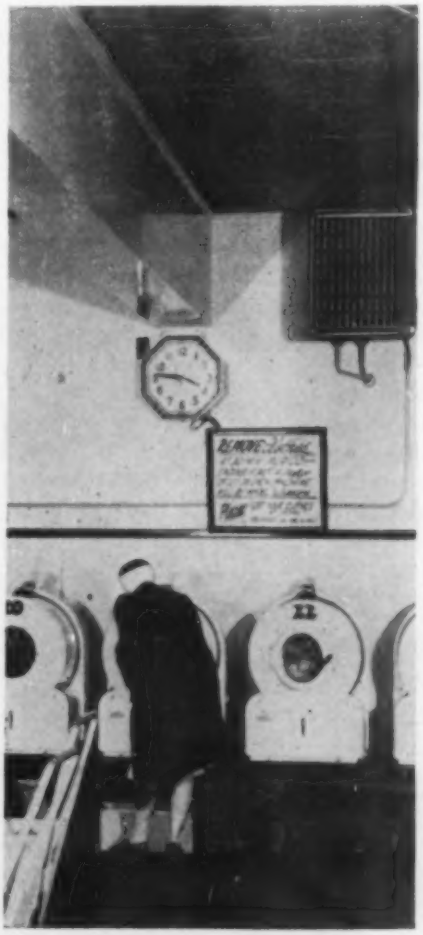


Fig. 1—View of weld prober used in sampling welded pipe joints to determine whether graphitization has taken place. The prober is a precision machine used by many piping fabricators and power companies for periodic sampling of welded joints, and is a neat and cleancut method. Other methods can be used, such as removing plugs with a trepanning circular hacksaw or cutting out wedge shaped pieces with an ordinary hacksaw.

Graphitization of Piping

AT HIGH TEMPERATURES, graphitization is a problem that must be considered in selecting the right material for power piping. Failure (attributed to graphitization) of a steam line at a power plant a few years ago, resulted in extensive investigations of the matter. This is the sixth progress report of a study conducted by the joint EEI-AEIC subcommittee on graphitization of piping, comprising L. E. Hankison, T. E. Purcell, Alex D. Bailey, chairman, and Sabin Crocker, secretary. We are indebted to Mr. Crocker, mechanical engineering consultant, system engineering dept., The Detroit Edison Co., a member of HPAC's board of consulting and contributing editors, for the Detroit Edison illustrations published with this report. Specimens shown in Figs. 3, 4, and 5 were prepared and photographed by I. A. Rohrig, research dept. metallurgist of that company

FIVE PREVIOUS progress reports on the "Fundamental Investigation of Graphitization" have been distributed in mimeograph form to those interested and published in the October 1943, April 1944, October 1944, July 1945, and February 1946 issues of the Edison Electric Institute Bulletin. The original and first supplementary programs at Battelle Memorial Institute have been substantially completed and it is now possible, with the aid of these findings and those of independent investigators made available through ASME papers* and otherwise to give reasonably definite answers to a number of the more important questions.

Most of the major objectives of the EEI-AEIC program have reached a stage of practical fulfillment. A commercial steel can now be specified with confidence that it will resist the usual graphitization process in present power plant operations—even at somewhat higher operating temperatures in the neighborhood of 1000 F. The important question of deoxidation practice can be handled and by the judicious use of at least one alloying element—chromium—a way is provided for removing any restrictions on that practice, thus materially simplifying the procurement of steel pipe and castings. It is also known that such a steel can be welded, fabricated, and installed in power stations by conventional methods. Sampling methods are available by which the present condition of a steam line can be ascertained with reasonable accuracy, and judgment of proper repair or replacement procedure, in view of the findings, rests on a sound basis. By means of kinetic methods of following the course of graphitization in selected samples, the effects of the more important factors of graphitization can be handled on a reasonably sound quantitative

*One or more sessions on graphitization were held during the annual meetings of the American Society of Mechanical Engineers in each of the years 1943, 1944, 1945, and 1946. Reprints of the 1943, 1944, and 1945 groups of papers have been distributed in bulletin form as well as printed in the Transactions of the ASME. The same course is under way with the 1946 papers.

basis. This assists in the interpretation of test results, in fact must become an element of such interpretation if the true perspective is to be had or if test results are to be correlated with service conditions. The latter is particularly desirable for setting safe operating temperatures for steels of the more readily graphitizable type. Stress-relieving treatments have been devised which seem capable of avoiding the segregated type of graphitization in moderately graphitizable steels and minimizing the formation of scattered graphite.

The bare recital of these points indicates substantial progress but, more broadly viewed, the question of steel for steam lines is still in a state of flux. For one thing, the power stations are pressing for higher operating temperatures of 1000 F or even 1050 F. On all sides, a single "high temperature" steel is desired for temperatures up to 950 or 1000 F and it appears that commercial considerations will force such an issue. Kinetic studies show that temperatures of 1000 F or more mean about a five-fold increase in the rate of graphitization over 900 F, although perhaps the two most serious questions that are raised are resistance to scaling and creep strength of the steels from which the selection will be made. With the higher alloy contents needed for resistance to scaling, stabilizing the carbide against graphitization, and giving sufficient creep strength, welding and other fabrication operations become more difficult for operating temperatures above 1000 F. Consequently, a single general purpose steel for temperatures above 1000 F seems out of the question until more experience is obtained with the pioneer installations now under way.

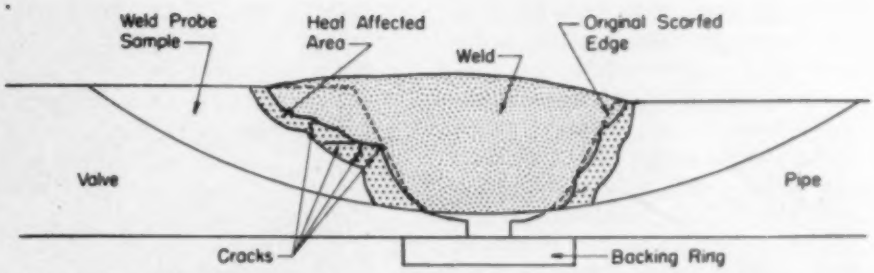


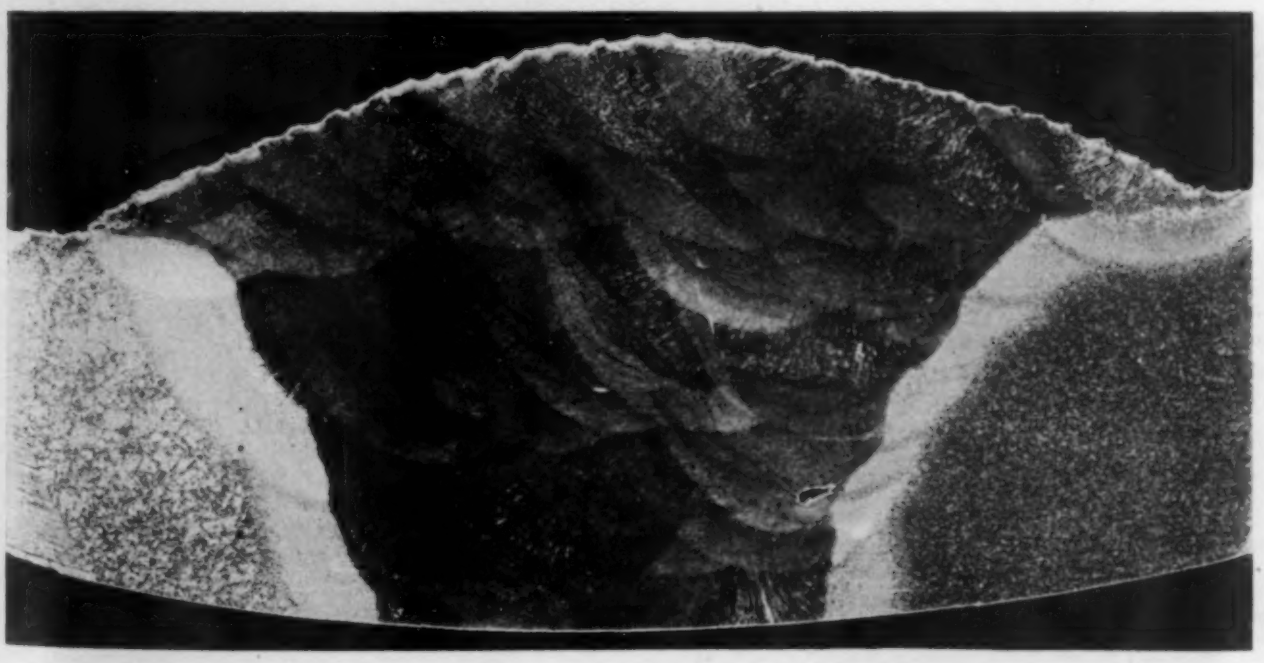
Fig. 2—This diagram shows how weld prober specimen sections across a pipe-to-valve weld without cutting completely through the wall; this facilitates subsequent repairs. Where desired, a specimen consisting entirely of weld metal can be removed at right angles to the position shown in this view

Items for Further Investigation

Certain specific items seem to warrant some further investigation in a limited extension of the research project at Battelle, such as continued heating of the molybdenum-titanium and molybdenum-vanadium specimens, and of the various chromium-molybdenum specimens, for another year or so at 1125 F. The heating period so far has been too short for establishing by chemical kinetics the graphitization characteristics of steels possessing such good resistance to deterioration of this sort.

Experience with the chromium-molybdenum steels, though considerable by now, does not yet point definitely to the one best composition, all things considered, nor does it cover conditions of stress like those described by R. W. Emerson in his 1945 ASME paper. As stated in Battelle's 1946 ASME paper, their efforts to evaluate the influence of elastic stress and plastic deformation were not completely satisfactory. While those factors were positively included in the experiments, the test results produced only negative results. It has been suggested that further tests be made by loading tensile bars at different temperatures until Luders lines appear, simulating Emerson's slip planes, and then heating the bars in a graphitization furnace to see what develops over various periods of time. Since this is doubtless the least understood phenome-

Fig. 3—Macro-photograph of etched specimen removed from carbon steel welded joint suspected of graphitization in the Conners Creek power plant of The Detroit Edison Co.

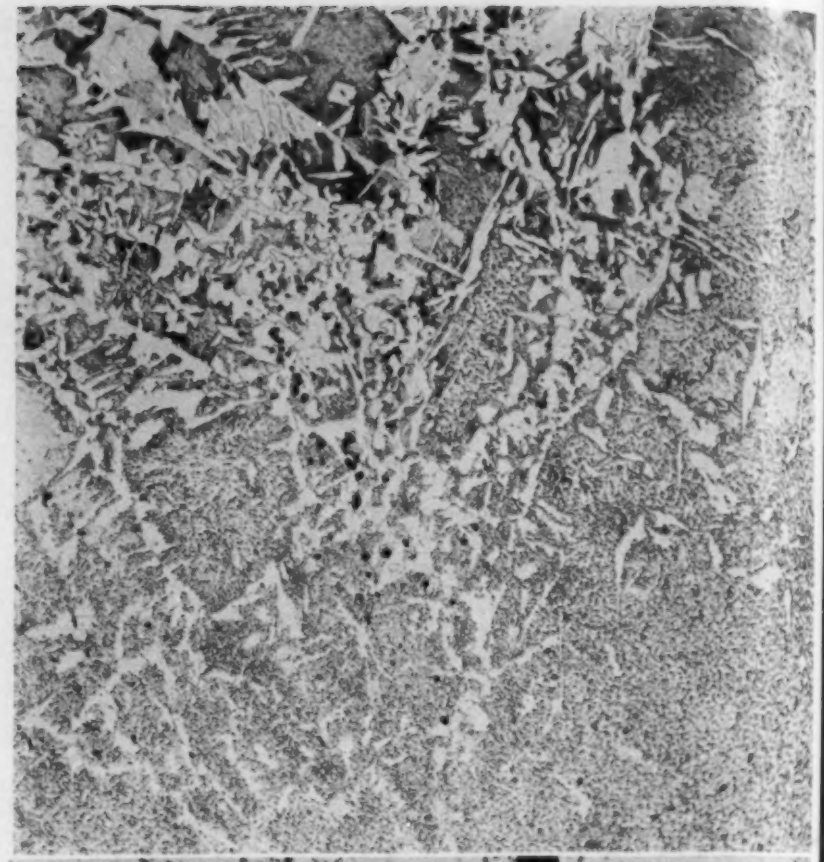


non of graphitization, it is felt that some further investigation along these lines is worthwhile.

The specimen of vanadium-molybdenum steel tested, which contained 0.23 per cent vanadium and 1.15 per cent molybdenum with only about ½ lb of aluminum per ton, gave very promising results in that it developed no graphite after 4000 hr at 1125 F. This class of steel warrants further consideration for high pressure steam line applications. From limited creep data, it seems reasonable to expect that the combination of molybdenum and vanadium is very effective on high temperature strength. For example, little gain in creep strength is secured in going from 0.5 to 1.0 per cent molybdenum (and none at all for the low stresses in steam lines) but the addition of vanadium should be of considerable help. On the other hand, neither alloy adds resistance to scaling, and for the new steam temperatures the necessary amount of chromium would be added for protection.

The elements in these steels are thought to function individually about as follows:

Molybdenum, vanadium, and chromium are all recognized as elements that tend to give alloy steel superior strength to plain carbon steel at elevated temperatures and, if present in proper amounts, doubtless effect carbide stabilization. The three together would contribute the necessary properties without serious question. On the other hand, these alloys make welding more difficult, and by increasing the air-hardening characteristics will require more careful handling in bending, stress relieving, and the like. On this account, the amounts added should be kept at a minimum. It may be noted that the vanadium would have to "pay its way." It is thought that there is a good chance that this will be true by its effect on strength; by reducing the wall thickness the operations of fabrication and welding will be correspondingly cheaper



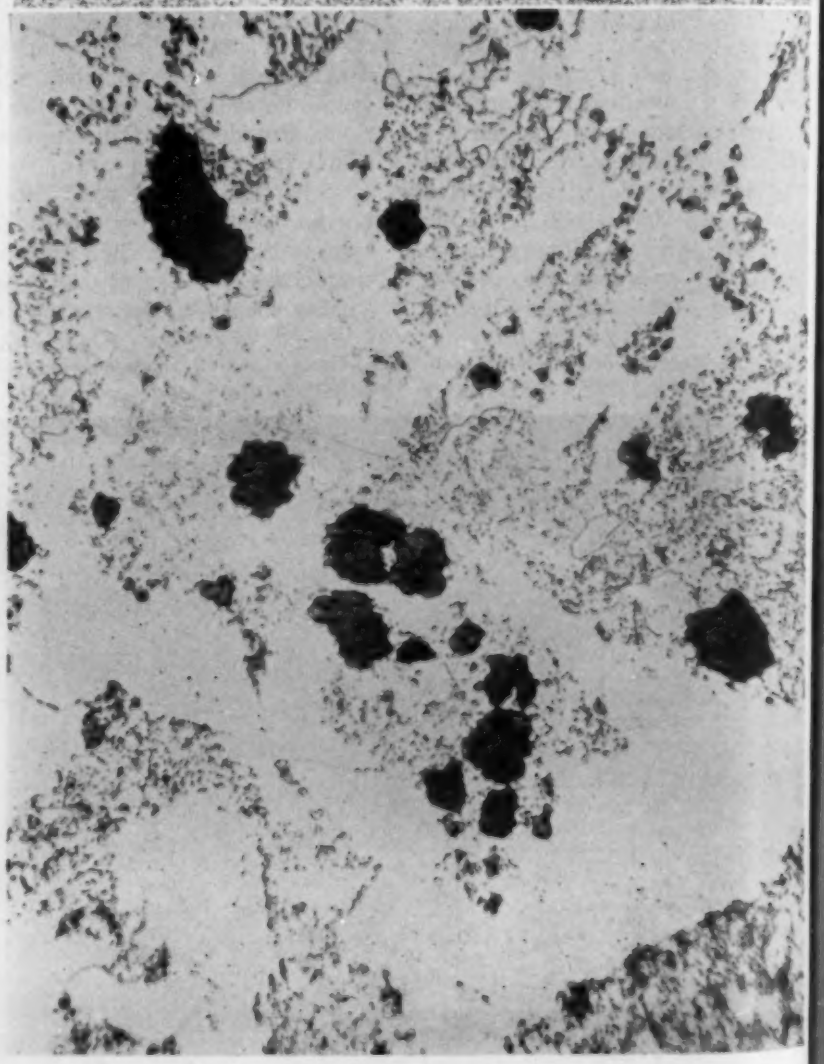


Fig. 4 (Top)—Typical graphite distribution in heat affected area at the pipe side of the weld shown in Fig. 3 —magnification 100 times

Fig. 5 (Bottom)—Typical graphite nodules of Fig. 4 shown at a magnification of 1000 times

while the lower weight will tend to offset the higher alloy cost.

Titanium is very much of an unknown quality in these steels, except as a carbide stabilizer, and it might be well to include it more positively in future work. Possibly a more fruitful study would be of the use of aluminum to lower the air-hardening tendency of the chromium steels in an attempt to improve their handling characteristics in welding and fabrication. A judicious addition might do a lot of good. With sufficient chromium present it is felt that the aluminum could not produce graphitization.

It has been suggested that wrought steels should be tested with both vanadium content and molybdenum content varied. In particular, it would be advisable to try to determine the minimum vanadium content required to provide satisfactory graphitization resistance, as well as to try to determine how this amount would be influenced by deoxidation practice.

Further tests designed to throw more light on the question of what microstructures are resistant and what are susceptible to graphite formation would be in order. In a project on tool steel, considerable attention has recently been paid to the effects of composition, deoxidation, and structure on graphitization tendencies and the teachings of that work might be used to advantage in clarifying the problem with pipe steels and to "explain" the concentration of graphite at the A_1 isothermal line of a weld. Incidentally, it is the acicular type of structure that was found to be particularly prone to graphitize. That is the structure, it may be recalled, that is apt to form at the A_1 isotherm (possibly martensite in some cases, but more likely bainite in most) and it is thought that this condition may be associated with graphite segregation in that location. Tapered bars or cones of plain carbon, carbon-molybdenum, and chromium-molybdenum steels, differentially cooled from elevated temperature to provide a range of microstructures, would be placed in the graphitization furnace. It is known that a graphitizable steel shows copious amounts of graphite in this test in 100 hr at 1300 F and this might be developed into a short-time test for pipe steels. If a given steel failed to graphitize after a predetermined time, when having the most favorable structure for graphitization, it would be concluded that it is satisfactorily resistant. The general purpose of the tests would be to probe further and more quickly into the relation between composition, structure, and graphitization.

A particular steel, which it is understood the English use in high pressure steam line applications at temperatures over 950 F, contains about 0.10-0.17 per cent carbon, 0.50-0.60 per cent molybdenum, 0.20-0.27 per cent vanadium, 0.40-0.60 per cent manganese, and 0.30 per cent maximum silicon. This steel is reported to be weldable, and tests of its resistance to graphitization and of creep properties at 1000 and 1100 F would be desirable.

Arrangements have been made for continuing the Battelle investigation a few months more on a limited basis to obtain a longer test period on the graphitization resistant steels that already have been in the furnace for about a year.

The problem now seems to be well enough understood to warrant leaving any further research work on new materials to the steel mills, valve manufacturers, and piping fabricators. Operating companies can continue such sampling programs as they deem necessary for existing welded joints in susceptible materials.

Retractable Ice Rink Used in Night Club

PATRONS of a New Orleans' night club recently were startled to see an ice rink where they had just been dancing. They were seeing for the first time one of the few retractable ice rinks in the country, the Refrigeration Equipment Manufacturers Association reports. Operating for two and three shows daily in the Blue Room of the Roosevelt Hotel, this disappearing rink was installed despite severe space limitations requiring a departure from previous engineering techniques.

The Equitable Equipment Co. solved the problem by designing a rink approximately 21 ft square with scalloped outside corners built to fit snugly around the building columns when the rink is extended. Direct expansion coils are built into the rink itself.

Space limitations were overcome by maintaining a clearance of 12 in. between the back of the rink and the rear wall. Liquid and suction headers, expansion valves, and connections for flexible hoses were located in this limited space. The compressor and condenser were located in a basement equipment room, one floor below and 30 ft to one side. Flexible metal inserted composition hose connections are used for the 30 ft of liquid and suction lines.

The bandstand is constructed of steel framing, completely spanning the rink. Clearance between the top of the rink and bottom of the steel framing was held to 7 in. Seven complete coil assemblies were constructed, each with its own expansion valves and distributors. Each coil consists of 20 lengths of tubing on 1¾ in. centers, with lines terminating in headers constructed to allow each of the seven coils equal distribution of refrigerant.

The coils are set in a steel pan of heavy gage steel with 4 in. of cork insulation, and lined with 24 gage galvanized iron with soldered joints. Sand covers the coils and is saturated with water for freezing. When this base freezes, the height of ice is easily built up to 2 in.

The pan is mounted on 44 ball bearing rollers, each 20 in. long, evenly spaced to spread the load and each equipped with an individual adjustment to correct for uneven spots in the dance floor. The rink is operated by a cross shaft, with a drum and cable on each side, and driven by a 1 hp back geared motor, giving an operating speed of about 22 fpm. Limit switches at each end of travel stop the rink at desired points. Control of the temperature is provided by a suction pressure control.

PLANNING TO AIR CONDITION?

Consider Architectural Appearance, Ownership of Equipment

THE ARCHITECTURE of an office building and appearance of air conditioning equipment or appurtenances may definitely limit the selection of such equipment to certain types of systems. It is recommended that the services of a consulting engineer be engaged to make a complete survey of the building and to present a design that will best meet the requirements. Some of the construction problems to be solved are as follows:

Duct Work in Corridors

Ducts running the length of corridors may be considered too unsightly in that they may mar the appearance to a prohibitive extent. A furred or drop ceiling to completely conceal the duct work may necessitate dropping the ceiling down too low, giving that corridor a tunnel-like effect. A furred ceiling may have to be dropped down to the tops of the door casings, the appearance of which may be objectionable.

Some of the floors may have higher ceilings than others; therefore, the above restrictions may not apply to the entire building. In such cases, a decision must be made as to whether uniformity of design and construction throughout will be maintained, or whether mixed systems will be used, treating each floor or group of floors separately.

Duct Work in Offices

Duct work in the offices may be considered too unsightly or for some reason may be prohibitive. This may apply to the entire building or to certain floors only. A decision will have to be made regarding this type of construction since it will have a very important bearing on whether or not a central plant system using duct work for the individual floors or the entire building may be used.

Office Group Installations

The office group installation comprises the complete installation necessary for a suite of offices, consisting of a compressor, cooling unit, and evaporative condenser. Evaporative condensers require a considerable quantity of air, so much so that it is uneconomical to draw the supply from the space to be air conditioned. Therefore, an outdoor air supply duct must be installed. The exhaust air is foul air, moisture laden, and must be effectively discharged to the atmosphere, where it will not condense on window frames or run down on the side of the building. The rotting out of window frames or the staining of the outside of the building could be a very serious objection.

An equally serious objection would be where this foul air is discharged from an evaporative condenser of an air conditioned suite, and re-entered the building through the open windows of an adjacent suite, either to the right or left, above or below the air conditioned suite—or it may be drawn into the outdoor air duct of an adjoining air conditioned office.

The above objections may be overcome as follows:

1) A design that will either remove the water and/or preheat the water vapor to the extent that no condensation occurs in the duct or around the outlet.

2) Discharging the air into the atmosphere at a high velocity sufficient to prevent the return of the air into adjacent offices.

Window Model Units

The extent to which the window model air conditioning units affect the external appearance of the building may be a serious consideration. In order to visualize the architectural effect of a complete installation, it would be advisable to have an architect prepare a projection drawing of the building, in color, with the room coolers mounted in the windows, and thereby obtain an accurate visualization of the result.

Some difficulty has been experienced in the past with the condensate from the room coolers collecting on the window ledges and running down the side of the building. This may be objectionable, and if so, the equipment selected should be such as to prevent such an occurrence.

Console Type Units

Console type units consist of small room coolers for individual offices, mounted in a cabinet resting on the floor, usually in front of or near a window. Outdoor air and exhaust ducts are required; these usually terminate at the window. As in the case of the window model units, a decision will have to be made as to whether the raised window with the blocked off duct work presents an objectionable external appearance. The possibility of discharged condensate on the external structure also should be investigated.

Recessed Wall Type Units

Recessed wall type units are usually mounted in a wall under windows. The cooling medium is supplied by a central plant, using the refrigerant as a direct system or chilled water as an indirect system. Outdoor air ducts are usually required, which may necessitate an opening to the outside for each

unit installed. These openings are relatively small and may be through the window sash or directly through the building masonry. The external appearance of such openings in a building may be objectionable.

Another type of recessed wall unit does not require an outdoor air opening, the new air being supplied through a duct from a central plant. In this case, an investigation should be made as to the space required by the supply ducts, their probable location, and whether or not any particular problem is involved.

Ownership of Equipment

It is not the intention here to indicate to a building owner or manager what his policy should be relative to the ownership of the equipment. It may be possible to pass the financial burden of the expenditure for air conditioning on to the tenants of the office building (in part at least) by adopting the policy of installing sufficient substation capacity, main and branch feeders through the building to supply the load, and then advising the tenants that they can have air conditioning if they pay for the equipment and have it installed. But there are many problems to be solved by such a procedure, all of which should be carefully considered, some of which are outlined as follows:

1) The maintenance problem will present many difficulties. Many types and makes of equipment may be represented. The maintenance probably will be done by men coming into the building from the outside, since it is unlikely that the maintenance men employed by the building can become sufficiently familiar with all types and makes of air conditioning equipment. The promiscuous running in and out of the building by repair men, hauling equipment in and out of the offices at all hours of the day, will most likely not be tolerated.

2) If the policy is adopted of doing all repair work at night, the matter of a man entering the building without advance notice and permission presents a difficult situation. Whether or not it is advisable to permit such repair men to gain access to the building and to the different offices unaccompanied by an employee of the office building must also be given consideration. Furthermore, on a given night

ARCHITECTURE OF the building influences the selection of the type of air conditioning equipment that should be installed, according to a report of the committee on education and research of the Building Owners' and Managers' Association of Philadelphia on planned air conditioning for office buildings presented by C. Robert Cheyney, operating manager of the Fidelity-Philadelphia Trust building, at the annual meeting of the Middle Atlantic Conference of Building Owners and Managers. Whether the tenants or the building should own the air conditioning equipment is another question with several implications.

there may be several repair men from as many different companies who wish to make repairs, adjustments, add refrigerant to, or pump down the systems.

3) There will be no uniformity of design or installation. Some tenants will give their contract for air conditioning to a reputable company with instructions to install a high grade system. Others will not be so much concerned about quality of product or performance, cutting costs as much as possible, and letting contracts based solely on price. Some of the air conditioning jobs will be good, others poor.

4) A great many of the tenants may have self-contained units with evaporative condensers. The foul air from the condensers may be piped to the windows where the condensate may collect and run down the windows and the side of the building. The foul air may blow directly into an adjoining office not air conditioned, or it may be pulled into an adjoining air conditioned office.

5) Separate wiring circuits will have to be run to each office or group of offices, or at least one circuit for each tenant, from some main distributing panel or feeders. Unless this is all done at one time, there will be no uniformity of design or construction. Existing panels or feeders may not accommodate more than a small fraction of the total load. Unless the total possible load for each floor is estimated in advance and suitable feeders provided accordingly and in advance of the requirements, the feeders to each floor may have to be reinforced several times before the job is finally completed.

1 DEG DIFFERENCE CAUSES DIRT MARKS

A temperature difference of but 1 deg between the walls of a room and the warmer air in the room will cause dust and dirt to settle on the walls, according to Westinghouse scientists. Nail heads and lath, presenting cold surfaces, attract dirt readily.

E. G. BAILEY TO HEAD ASME

The 1947-48 president of the American Society of Mechanical Engineers will be E. G. Bailey, vice president of the Babcock and Wilcox Co., manufacturers of steam generating equipment. Mr. Bailey was nominated for the office at the semi-annual meeting of the society last month. Nomination is tantamount to election, since only one nominee is named for each office.

PLANE LAYS RUBBER PIPE LINE

A helicopter flying at 40 mph at a height of about 20 ft laid a 400 ft rubber pipe line in about 25 seconds during a demonstration at the Army Engineer Center, Ft. Belvoir, Va., recently.

The method is expected to have many military as well as civilian uses, particularly for conveying water and gasoline.

The hose is folded into a special container and is released by the pilot at the press of a button.

400 ft in 25 seconds

Acme photo.

Unique System Serves Heating Distributors

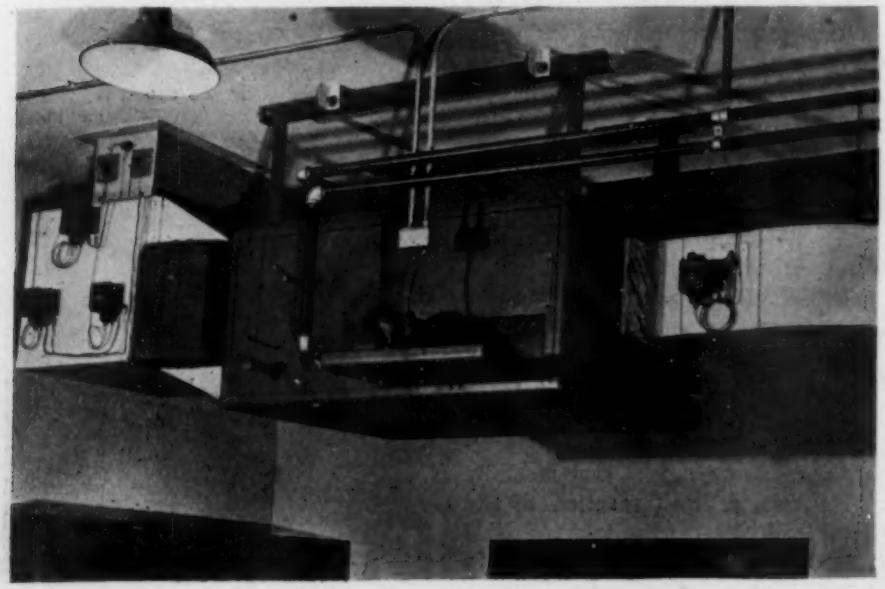
WHEN H. O. BERG, president of the Bryant-Berg Co., Hammond, Ind., and distributor for the Bryant Heater Co. since 1939, decided to erect a new building to better house his expanded operations, he took the design of the heating and conditioning systems in his own hands. Aside from insuring an advanced system for first-class comfort conditions the year 'round, personal supervision of the layout provided the opportunity to introduce special conditions for purposes of demonstration and test.

Floor Panel, Conditioning Unit, Unit Heater Demonstrate Equipment and Provide Comfort

It was decided to incorporate various forms of heating and to vary the construction of the building in order to be able to illustrate and demonstrate not only the effect of the various forms of heating, but the effect of different construction as well.

The front portion of the building, which incorporates the showroom and offices, is constructed with 4 in. brick, 8 in. haydite block, furred with 1 in. x 2 in. furring strips with 1 in. rolled batt insulation between the haydite blocks and rock lath and plaster. The storage space to the rear of the building is of 4 in. brick and 8 in. haydite block only. However, the ceiling is insulated with 4 in. of rock wool over all.

The air conditioning unit has hot water heating and direct expansion coils



Floor Panel for Front End

Because of the tremendous interest in radiant heating, the job features a floor panel capable of heating the entire front end of the building. It was also decided to install year 'round air conditioning with overhead air distribution; the conditioning unit includes three row hot water heating coils of sufficient capacity to heat the entire front end of the building.

The gas fired boiler supplying the hot water to the radiant heating and air conditioning unit is oversized from the standpoint of the heat loss requirements. However with the radiant coils imbedded in concrete, it was anticipated that the pickup load would be large. It was thought that it would be essential to have this pickup capacity in the event of shutdown during a cold

eriod and subsequent reheating rom the cold start.

The storage area at the rear of he building was ideal for the ap- lication of a unit heater.

Automatic Control

The air conditioning unit incor- orates a four row direct expansion ooling coil operating in conjunc- ion with a 3 hp "Freon" compres- or. The system as originally de- igned was fully automatically con- rolled by the following:

Air Conditioning Unit: Modulat- g type heating and ventilating ermostat; modulating discharge uct controller; modulating three- ay mixing valve; "cooling" ther- ostat; relay; "freezeup" controller ith well and pressure fitting; modu- ting damper motor with bracket nd damper interlinks; potentiom- er type damper positioning switch; utside air controllers.

Radiant Heating: Modulating type utside air controller; modulating hree-way mixing valve; well and ressure fitting; special reset panel cluding wind and sun compensat- g control, automatic night shut- own and morning pickup, control elector, manual valve positioner, and rovision for circulating pump shut- own.

The above outlined system makes possible to demonstrate the con- rol and operation of a radiant eating panel as well as the opera- ion and control of the air condi- ioning system. It is also possible o illustrate the difference in heat- ng requirements with different all constructions and the bene- icial effects proper insulation af- ords in both heating and cooling. n addition, the opportunity is af- orded to check the inside surface mperatures of the two types of all constructions with varying utside temperatures.

Experience with Radiant Heating

After a winter's operation with a radiant floor panel and year ound air conditioning system, Mr. erg believes that such a combina- ion is ideal for commercial sales ffices. The radiant panel provides floor warmth "that adds immeas- rably to the comfort of the occu- nts." The air conditioning sys- m provides ventilation, air circu- ion, and flexibility of control, hich are essential in this type of ice usage. According to Mr. Berg, would be difficult to hold meet- gs and conferences in small offices ithout this ventilation and air cir- lation.

Due to the inertia of a large concrete floor panel, it was found that the night shutdown and pickup control was not satisfactory, and the layout was changed to utilize these controls on the air conditioner. The radiant panel was then kept at a constant temperature by means of the three-way mixing valve controller in continuous operation. With this operation, the floor was kept at a temperature of 83 to 85 deg, which temperature proved very satisfactory.

During the experimenting and checking period it was found that when the temperature of the radiant panel was 90 deg or higher that most of the occupants were uncomfortable. This was especially true in the offices, as the temperature in these spaces was then 4 to 6 deg higher than in the general office.

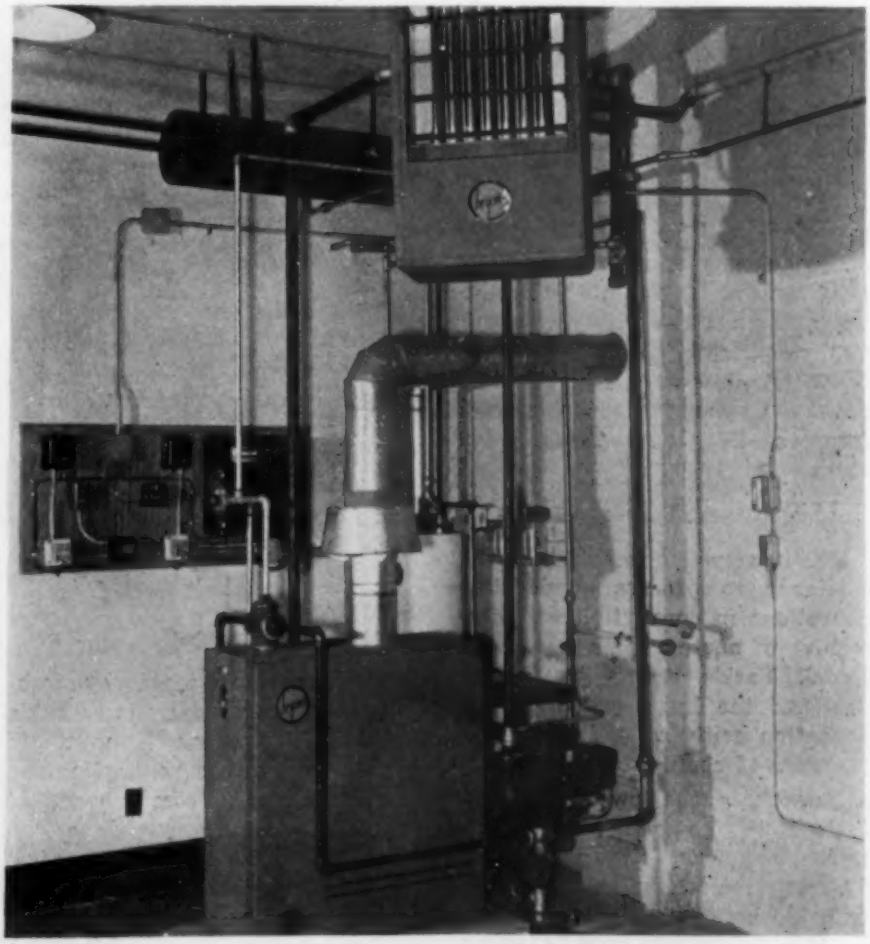
At a floor temperature of approximately 95 deg this uncomfortable feeling was akin to nervous irritation, which was not conducive to good working conditions. The change to keeping the floor panel at a temperature of 85 deg or slightly

WHEN BRYANT-BERG CO. erected a new building to house expanded operations, advantage was taken of the opportunity to install heating and air conditioning equipment not only to provide comfort but to demonstrate it and its control to prospective customers. The installation is briefly described here, and results of the first winter's operation—which resulted in a change in the control of the floor panel —are reported

below, with the air conditioner supplementing the heating and providing ventilation, proved to be much more satisfactory.

The interest in the heating and the construction of this office building has been very gratifying. It has been found much easier to promote good heating by being able to illustrate the necessity of adequate insulation of the building and the use of controls in the operation of the heating system. Clients find it possible to *feel* the importance of each component part as it would affect his own comfort.

These gas fired units are conveniently located in the storage area.



85-Below-Zero Refrigeration System Being Installed at Kodak Park

A MILLION-DOLLAR, 85-below-zero refrigeration system—in some respects believed to be the largest of its kind in the world—is under construction at Eastman Kodak Co., Rochester, N. Y. The new system will be used at Kodak Park, the company's largest manufacturing plant and producer of photographic film, paper, plates, and chemicals.

Cooling units each capable of turning out 375 tons of refrigeration daily at minus 85 F will be utilized in the new plant. So far as is known, no machinery of equal size ever has been built before to provide that temperature for big-scale industrial operation, according to Kodak engineers.

Nickel Steel Piping

The brine piping for the system, in addition, is regarded as the most extensive ever planned for refrigeration at 85 deg below zero. Almost two miles of pipe, 18 in. or less in diameter, will be used. The pipe will be of nickel steel because ordinary steel tubing becomes brittle at the extreme temperatures in which the system will operate.

Another record for such a system, it is believed, is the volume of cooling liquid, or brine, which the plant will contain. This will be approximately 100,000 gal of methylene chloride, selected because of its very low freezing point. Ordinary brines would freeze at the temperatures to be used.

19,000 Tons of Refrigeration

The new system will bring added efficiency to process condensing operations in connection with the making of photographic materials. Kodak Park's power department designed the huge system in cooperation with a leading manufacturer of cooling machinery.

Previously, the lowest temperature in the company's refrigeration plant was minus 36 deg. That system circulates calcium chloride brine.

The company's cooling plant, in its entirety, is one of the largest in existence and has a total rated capacity of about 19,000 tons of refrigeration per 24 hr. In the new system, which will be a part of the entire refrigeration plant, two units—each with a 375 ton daily capacity—will be installed this year and other units are planned for the future.

The new units will be powered by two turbines of more than 2300 total horsepower. Each of the units will circulate about 2300 gpm of methylene chloride. Standing about 17 ft high, each machine will occupy a floor space of approximately 22 by 36 ft and will operate at a vacuum of about 27 in. of mercury.

Kodak Park's refrigeration plant, as a whole, is made up of several different systems operating at various temperature levels. The combined setup comprises, it is believed, the world's largest of its type—an interconnected refrigeration plant.

Turbines functioning throughout the whole system vary from 800 to 1400 hp and motors of 825 to 1500 hp also are utilized in running the cooling machinery.

Other Systems

Besides the new, minus 85 deg system, the plant operates others at these levels: a minus 36 deg system circulating 14,000 gpm of calcium chloride; two separate 9 deg systems, each pumping 4000 to 5000 gpm of calcium chloride; and four 35-40 deg water systems, each from 200 to 7000 gpm.

SUMMARIZES FUEL OIL OUTLOOK

Developments in refinery techniques and particularly in catalytic cracking have made it possible to obtain more and more gasoline and middle fractions from a barrel of crude oil. As a result, there is a reduction in the amount of residual or heavy fuel oil, and it is not economical for American refiners to run crude oil to produce heavy fuel, according to J. W. Connolly, Standard Oil Co. (N. J.), at the recent convention of the Oil-Heat Institute. The present yield of residual fuel is about 25 per cent on crude, and it may go below 20 per cent in the next 10 years, he said.

There are a few factors which may supplement domestic residual supplies, however, after the next two or three critical years, he stated. The main one is that, although it is not economical for American refineries to run to heavy fuel, foreign refineries, because of availability of heavy crudes, are able to produce residual fuel and realize a fair return from it. When damaged refineries abroad are rebuilt it is anticipated that they will process Middle East crudes. Middle East crudes, therefore, may displace much of the South American fuel now going to Europe, and this displaced South American fuel will then be available for import to relieve American demand.

Even after allowing for these factors there may be a slight tapering off of residual fuel supplies in this country, with demand being tailored to fit supplies at somewhat less than the 1946 level of 477 million barrels.

An Excellent Fuel

It may be possible to increase the supply of No. 5 fuel oil at the expense of No. 6 residual fuel, he said. This product is the equivalent of a blend of residual and heating oil fractions. Increased supplies of this product undoubtedly will be made available if there is sufficient demand and attractiveness of price to the refiner. No. 5 has definitely attractive possibilities, he mentioned. It is an excellent fuel for apartment houses, for example, where a furnace man cannot be on hand 24 hr a day.

To summarize a study of the outlook for the next 10 years, Mr. Connolly said that kerosene demand will rise for a while and then level off; heating oil will continue to increase steadily. Kerosene and heating oil supplies should be adequate to meet requirements. Residual consumption will be limited by supply, which is expected to be tight. Additional supplies of No. 5 fuel oil may be made available.

Identifying Piping Systems

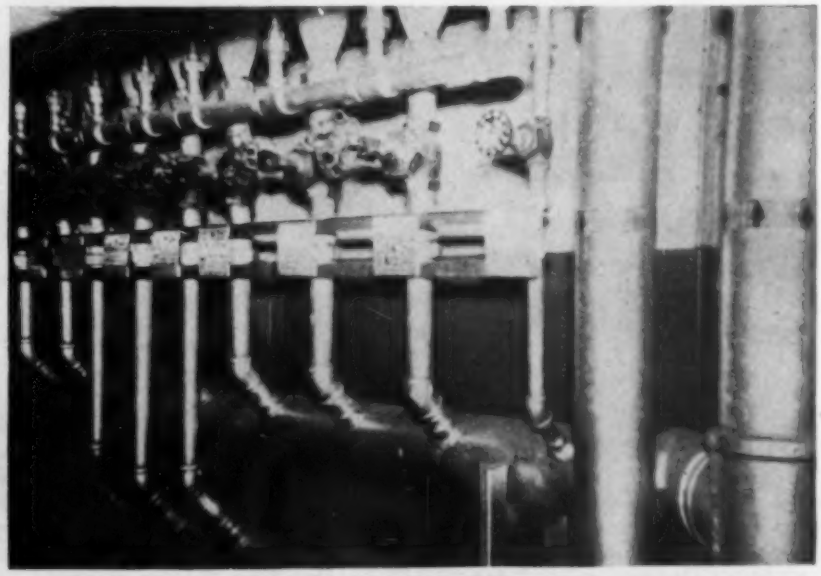
Marshall Field & Co. Uses Adhesive Marker Strips for Pipe, Metal Nameplates for Valves

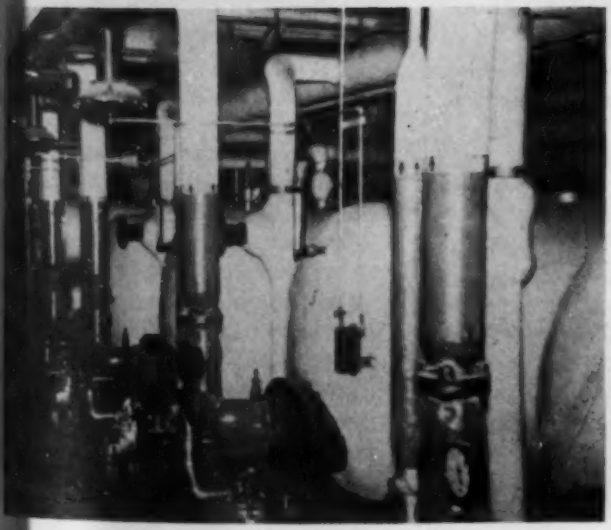
MARSHALL FIELD & Co., world-famous Chicago department store, is currently identifying the many piping services in its big State St. building to simplify operation, maintenance, alteration, and extension work. The problem came up particularly when contractors' men on air conditioning and other projects had to make connections to existing lines in pipe shafts on upper floors; however, all piping—both in the shafts and in the basement areas—will be identified to simplify the work of the store's own personnel as well as outside contractors.

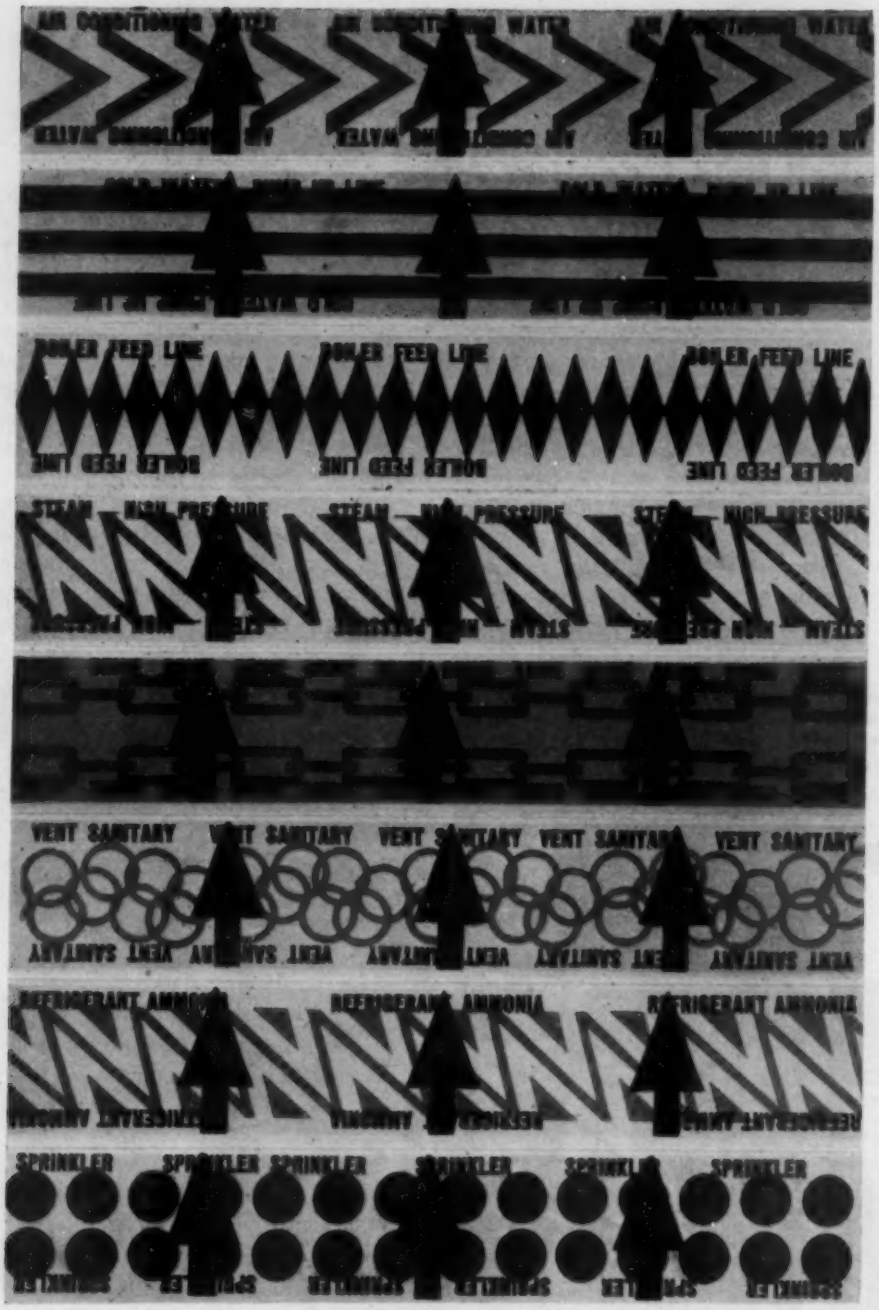
Standard identification markers are being used. They are strips 1½ in. wide by 9 in. long, each of which comes on a small card. The strips have an adhesive coating on the side against the card and when pulled off the card the strip may be applied directly to the pipe.

The strips are printed in color, the background agreeing with the American Standards Association scheme for identification of piping —yellow for dangerous materials,

Top Left: Several overhead pipe lines in a basement area, showing the identification strips. Top Right: Valves at Field's are identified with metal nameplates neatly mounted on a rack. Bottom Left: The strips not only indicate by design and lettering the contents of the pipe but the arrow heads also show the direction of flow. Bottom Right: The value of identifying piping services is particularly apparent in a pipe shaft such as this







Adhesive marker strips, with color backgrounds in accordance with the ASA code on identifying piping, are being used by Marshall Field & Co.

green for safe, and red for fire protection. A blue background can be had for protective materials and purple for extra valuable materials. Arrow heads show the direction of flow in the pipe. The symbols are in blue for liquids and in green for gases. Orange symbols on a white background are used for identifying electrical conduit.

Referring to the accompanying illustration of the markers being used by Field's, the colors are as follows (reading from top to bottom):

Air conditioning water—Green background with blue design, arrows and lettering black.

Cold water pump up line—Green background with blue design, arrows and lettering black.

Boiler feed line—Yellow background with blue design, arrows and lettering black.

High pressure steam—Yellow background with blue design, arrows and lettering black.

Brine—Green background with blue design, arrows and lettering black.

Sanitary vent—White background with green design, arrows and lettering black.

Refrigerant (ammonia)—Yellow background with green design, arrows and lettering black.

Sprinkler piping—Red background with blue dots, arrows and lettering black.

In addition to the use of these adhesive identifying strips on the pipes, Field's is also marking valves with metal nameplates. For instance, the plate on one valve reads "Valve No. H27—Hot Water Return—from SW-2 & up—via Shaft No. N13 (SW)—For supply see H7." In this marking, "N" and "13" are coordinates indicating the location in the building and "SW" means "South Wabash." (The main store occupies the block bounded by State, Randolph and Washington Sts. and Wabash Ave.)

(Acknowledgment is made to H. W. Steere, manager of mechanical service of Marshall Field and Co., and John Cheatham of his department for their courtesies, as well as to Western Lithograph Co. for the illustration of the identifying strips.)

PIPE ORDER BOOKS FULL TO 1950

In a statement issued last month on the availability—or lack of it—of heating, piping, and plumbing products, the Crane Co. stated that (according to the American Iron and Steel Institute) last year over 4¼ million tons of butt weld, lap weld, electric weld, and seamless pipe and tube were produced for direct use. In the first two months of 1947, 775,260 tons were produced for direct use (for use as pipe, not for assembly into other manufactured items). At this rate 1947 production could surpass 1946 by considerably more than ½ million tons. This sounds like tremendous production—and it is—but requirements are even more tremendous; AISI records show that every major manufacturer of pipe has his order books full all the way to 1950. In other words, even if no additional orders came in from now on, it would take until 1950 to supply all of the pipe already ordered.

At present the outlook is good, the statement concluded. Order backlogs are being whittled down a little more each month. It is hoped that by the end of 1947 most heating and plumbing items will be in full (although still not plentiful) supply.

Clean Your Ducts *for Better Results!*

"Starting at an air intake at, let's say, the tenth floor roof, they are lowered down the stack on a bos'n chair." (Chicago Daily News photo)

George L. Candler Tells Why Ductwork Must Be Cleaned, How It Should Be Done, What to Watch Out For

CHARLIE SMITH, president of the Smith Corp., was a mighty happy man the day the contractor completed installation of the brand new air conditioning system. Mr. Smith was very proud of his modern plant and now that it had been air conditioned for the comfort of his employees and visiting customers, he felt that he had achieved the ultimate!

But one day, about three years later, something unforeseen happened to dampen his spirits. "C. S." was surprised to notice dirt coming from the grilles and making unsightly smudges on his beautifully decorated office walls and modern acoustical ceiling. About the same time, his office manager was bringing the night porter to task because a daily film of sticky grime was appearing on desks and papers. Yes—the Smith Corp. air conditioning system was beginning to throw dirt and, try as he might, the porter could do little about it.

Being a man of action, "C. S." phoned his ventilating contractor, who told him he would send a service man over at once. The man arrived, satisfied himself that the air filters were being changed regularly, and informed "C. S." that the only remedy for the situation was to call in a firm of duct cleaners and have the entire system cleaned! Now, if you will multiply Mr. Smith's problem by several thousand, you will understand why the business of cleaning ventilating systems is becoming a large and essential industry.

My firm's business happens to be industrial cleaning and fireproofing. A very large portion of our business comes from industrials, restaurants, department stores, hotels, office buildings, and places of amusement—many of which have a ventilating system cleaning problem. With few exceptions, the management of these establishments sees to it that the air filters in the ventilating systems are changed regularly, but as far as we know after varied experience, no filter has been created that will keep back *all* of the dirt. Eventually, maybe after two years or 10, the dust and grime accumulates in the fan chamber and ducts beyond the filters and commences to blow out of the grilles or outlets.

Eyesore and Hazard

Aside from being an eyesore and health hazard, this "fly ash" (as it is often called) ruins expensive decorating, quite often spoils valuable merchandise, and is always a constant fire menace. A spark from

HOW TO PROLONG the periods between cleanings of ventilating and air conditioning systems, the qualifications of a reliable firm of duct cleaners, what duct cleaners do, and the importance of allowing for accessibility for cleaning are explained here by George L. Candler, president of the Airways Fireproofing System, Inc. His remarks are of value both to those who employ a firm of duct cleaners and to those who have their own men do the work

a fan motor, igniting an accumulation of dust and fuzz in the fan chamber and then fed by a further accumulation in the duct, can start a very hot conflagration which is apt to travel throughout the duct system.

Also, cooling efficiency is reduced if the cooling fins become coated and heating costs rise when the heating coils are covered with scale. So it is no wonder that crews of ventilating system cleaners operate around the clock to remove tons of dust, dirt, and grease from all types of supply, exhaust, and combination systems.

Certain factory exhaust systems as well as hotel and restaurant kitchen systems represent a particularly serious problem. Reports of "grease chute" fires fill the fire department and insurance company records.

However, before you throw up your hands in horror and decide to tear out your ventilating system, let's see just how serious this situation is and what can be done to alleviate it with the spending of a little time and eventually some money.

If you operate an air supply system in your place of business, you probably have filters. In accordance with your contractor's instructions, you are having these filters changed at regular intervals by a service company on the outside or someone in your plant is keeping them clean. Before changing the filters, it would be well to have vacuumed away any accumulation of dust or other foreign material from around the filter frames so that it will not find its way into the system when the filters are disturbed for changing! [And—of course—never change filters while the fan is in operation!] Also, check carefully to make certain that there is no bypass between filters or filter frames, for foreign matter to fly through into the ducts. It doesn't take long for a few hundred pounds of dirt to be blown through such a bypass.

Watch your oil filters, if you have any, to make certain that they are not *drying out* when the system is turned off over night or Sunday, only to blow into the ducts a large quantity of dry scale when the system is turned on again Monday morning. If you are using washed air, the spray pipes as well as the tank should be cleaned annually.

Watch Out for Racketeers!

So much for how to *prolong* the periods between cleanings of the entire system. When at last the tell-tale smudges and flying dust appear, resign yourself to having the system cleaned, but *have it cleaned properly!* Like everything else that is commercialized, there is ample room for racketeering in the duct cleaning business. Too many who are anxious to earn a few dollars without too much effort claim to know their business but are very apt to give you the "business" instead!

Most cleaning of ventilating systems is done at night or over the week-end when only a busy porter or otherwise occupied watchman is on the premises. Beware of the duct cleaners whose charges sound unusually low but whose intentions are to remove dust and dirt only as *far back* into the duct as you can see with a flashlight. To contract for such a service is just like throwing money out of the window.

A reliable firm of duct cleaners should have the following qualifications to warrant your confidence and receipt of your money:

1) They should carry both property damage and liability insurance in an amount that would be ample to take care of any possible accident involving your property or one of their men while on your property.

2) They should come well recommended by companies which have given their service the "acid test," such as large industrials, department stores, office buildings, restaurant chains, or others that employ competent maintenance engineers who actually crawl into the ducts and check the service after it has been rendered.

3) They should provide a written guarantee of satisfaction; that is to say, if any further dirt comes out of the system within six months they will provide re-service without charge. In other words you are paying your money to overcome a problem and you want to make certain that you are getting what you pay for. It has been our experience that the average air supply system, properly filtered, will operate three or more years without cleaning.

What Duct Cleaners Do

Now, just a word about what duct cleaners do. In the first place, a good man in this business is of higher caliber than you would probably suppose. Most of the better duct cleaners are married and rearing a family. Many are buying their own homes. All of them are sober and reliable (they must be to stay alive, for this is dangerous work) and while they work only five nights as a rule, resting up over Saturday, Sunday and all day Monday, they bring home paychecks that would make many a skilled tradesman, department head, or professional man quite envious. For, you see, these fellows risk their lives regularly doing just about the most disagreeable kind of work you can imagine.

Starting at an air intake at, let's say, the 10th floor roof, they are lowered down the stack on a bos'n chair, cleaning with brush-suction equipment, especially designed for the purpose, as they go. Upon reaching the fan chamber, they are apt to spend many hours in a cramped position removing scale, grease, dust, and dirt from the fan and its housing. The cooling fins must be washed clean with a special cleaning solution and then neutralized. The heating coils must be brushed free of rust and dirt which is taken into the suction equipment. Any rust in the fan chamber must be removed and the surface painted over with a rust resistant paint.

By now the service has really just commenced. Perhaps half a mile of narrow, dark ductwork must be crawled through and cleaned thoroughly. This duct is often studded with protruding screws which could cut an artery. Once entering such a duct, a crew member is often in a cramped crawling position for hours before he reaches an access opening from which he may emerge.

Grilles must be carefully removed from freshly decorated walls without marring the finish. This means

"Perhaps half a mile of narrow, dark ductwork must be crawled through and cleaned thoroughly" (Chicago Daily News photo)

careful cutting around the edges with a special tool before loosening the screws—no easy task when your hands and coveralls are covered with greasy dirt from the ducts. Also, where the duct is too small for even small men to enter, access openings must be cut and airtight covers applied.

Meanest Work of All

Perhaps the meanest work of all is removing cooking grease which has congealed, or is still in a liquid state, in the restaurant kitchen exhaust system. It is often quite necessary actually to crawl through liquid grease an inch deep in order to remove this well known fire hazard. Some people have advocated the use of hydrated lime (often given fancy trade names) as an agent to be blown into the system in order to dry up the grease. Our own experience with this agent has not been satisfactory, however, and we remove all of it from ducts wherever it is found. When blown over grease it tends eventually to block up the system, thereby reducing efficiency. It coats the fan blades, finds its way into fan motors and we are convinced that only a *clean* duct will not burn.

Perhaps I should say that the policy we insist upon with our men is to put the system, *every system*, back as close to *new* condition as possible. After all, that is what the customer originally had installed on his premises and it is our business to help him keep it that way.

If you are planning on having a ventilating system installed, be sure to discuss "accessibility for cleaning" with your engineer and contractor before the final plans are approved. Remember that "fly ash" cannot be drawn out of a ventilating system through *suction alone*. This material adheres to the sides of the duct, fan chamber, and fan blades and must be loosened with a brush before it can be drawn away. Therefore, if any portion of the ductwork is smaller than a minimum of 14 in. by 14 in., access openings should be provided at 10 ft intervals so that the duct cleaners can reach in with extensions and remove the accumulations in the system.

Accessibility for Cleaning

Particular attention should be paid to portions of the ductwork where it bends, to make certain that it is accessible for cleaning. It is at these bends that dirt and dust piles up the most. Arrangements should be made so that the fan wheel itself is accessible to cleaning. The duct that lends itself most easily to cleaning is one large enough for a man to crawl through.

Your contractor will be more than anxious to cooperate in making the system accessible for cleaning, but there is extra expense involved in cutting these access openings and fitting doors or sliding covers, so be prepared to stand this added expense. We have had contractors tell us that competition is often so keen in bidding on installing a job that they are forced to reduce actual cost to a minimum. Then, too, in thinking about all the advantages of a ventilating system at the time of planning, no one brings up the unpleasant subject of eventual cleaning of the system!

Just in case you are located where no reliable ventilating system cleaning service is available, you may be glad to know this: Two years ago we set up what we believe to be a rather complete training program for men who were interested in entering this business. There are now reliable operators in many cities and additional thoroughly trained men are spreading slowly throughout the country. Many of these fellows are vets who, in going down stacks and crawling through ducts, must often think that the war wasn't so tough after all!

ANTIFREEZE PROTECTS COOLING COILS

One of the problems in the operation and maintenance of air conditioning equipment is the complete removal of water from the water cooling coils in the winter time to prevent freezing, with subsequent damage to the coils.

We have tried blowing out the coils with compressed air, but in some instances enough water remained in some of the bends to cause damage. Therefore, we hit upon the scheme of using one of the antifreeze fluids used in winter in automobile radiators as a solution to the problem. Our method is to first blow out the coils and then pump this nonfreeze solution through the coils, removing as much as possible. The manner in which this is done is to use a barrel on wheels or a barrel on casters, fitted with a hand pump. The fluid is circulated through the coils and returned to the barrel and then moved on to other units.

In the course of time, this liquid will naturally pick up some water which, of course, can be readily boiled off from time to time. It is not necessary to keep the coils filled with this solution, but we do know that whatever does remain will not freeze and injure the coils. —W. E. LOWELL, air conditioning engineer, Miles Laboratories, Inc.

SAM LEWIS' PAGE

"Lazy" Zoning Causes Heating, Cooling Troubles

A LAZY MAN—made to do the housecleaning—will sweep the litter under a bed or even under a rug. A lazy minded engineer will do the same sort of "housekeeping" when it comes to zoning for temperature control, and it is time that something emphatic should be said about such practices.

My attention was reawakened particularly by a rather nicely conceived and excellently carried out complete air conditioning plant in a hotel. As a measure of hoped-for economy, the three main air delivery ducts from one 20,000 cfm air supply system were divided into:

1) A zone for the main first story restaurant that is located on the north and west corners of the building and that has very large plate glass windows from floor to ceiling on two sides;

2) A zone for the basement cocktail room that has practically no outside exposure to either winter wind or summer sun;

3) A zone for the basement kitchen, bake shop, and service departments that have no windows, and that are always warm.

Each of these zones has a room-located thermostat that controls a steam supply valve for a convector or booster in the respective branch air supply duct. There is a summer-winter duct thermostat between the supply fan outlet and the three-way junction in the main supply duct on the fan side of the three boosters.

So far there is no conception of iniquity in the design. However, Zone No. 1 has direct steam radiators along the outside walls below the glass and the thermostat in Zone No. 1 has no control over the heat given off by these radiators. On a cold winter day these radiators are exceedingly helpful in maintaining comfort for the restaurant patrons who must sit close to the cold glass walls. Thus, some one opens manually the supply valves to the radiators and forgets about them. Then the weather moderates and bitter complaint comes from patrons of the restaurant of cold drafts from the overhead air diffusers of the ventilating system. Of course the poor little thermostat, sensing the too-warm air currents resulting from the radiators, has done what it could about the matter and has caused introduction of air at 60 deg overhead in a room where the hot radiators have brought about a temperature of 80 deg.

Control All Controllable Heat Sources

Perhaps sometime the contractors for automatic temperature regulation will have sufficient intestinal fortitude to refuse to sell or to install a thermostat in any room unless the thermostat shall have means of controlling *all* controllable heat sources. They will save time and money and will avoid fractured goodwill when they follow that practice.

Zone No. 2 in this hotel has a room thermostat and a separate booster in the long, tortuous air supply duct for the cocktail room. The room does no visible business during any day until well along in the afternoon and has so little heat loss or gain except that from its patrons and lights that it could be unventilated or at least could have 100 per cent recirculation when unoccupied. However, if the general air supply system runs, this room (as arranged) must be ventilated and refrigerated and heated continuously at a very considerable operating cost. Here would have been an excellent opportunity for a separate air circulating system devoted exclusively to the room.

Kitchen, Locker Room, Store Rooms, Office on One Zone

The third zone followed city code requirements in that the kitchen must receive a modicum of new air directly from outdoors and as designed this air must be refrigerated if any air is refrigerated. Apparently to reduce the investment cost by providing a single supply fan for all three zones, the designer sends refrigerated air in summer to this hot kitchen and has a thermostat on the wall in the room controlling a steam supply valve to a booster convector in the duct.

As a measure of "underbed sweeping," the designer also connected to the kitchen air supply duct a lot of basement store rooms, employee locker rooms, and the hotel auditor's office. Thus, when business in the kitchen is good, the thermostat not far from the hot appliances yells for help and the zone duct receives air as cool as 60 deg. Now the auditor and his staff find air entering at 60 deg a little nerve-wearing and I do not blame them. The cook's staff, well sweated, would enjoy a shower at the

end of the day's toil, but a shower in a 60 deg air draft is not popular and these shower faucets will last quite a while without extensive repairs.

The engineer responsible for the design of the plant in this hotel doubtless will read this and I hope his face will be red.

Lazy Zoning in Large Office

In a large general office I found the same sort of lazy zoning. The room is 200 ft long and 60 ft wide, with a west exposure for 200 ft and a north-south exposure for 60 ft. All along the west and north and south are private offices, each office having a steam convector with the valve so cleverly located that one must lie on the floor and must reach in and up behind the air inlet to manipulate it. They provided two thermostats for the great room

In this regular feature, informal comment on heating, piping and air conditioning matters is given by Samuel R. Lewis, consulting mechanical engineer and member of HPAC's board of consulting and contributing editors. This month he cites some "horrible examples" of improper zoning of heating and air conditioning systems in a hotel and for a large office area, and tells of the difficulties caused

though the interior area has practically no exposure. These two thermostats are placed in west private offices that do have exposure. It follows that the northerly thermostat in summer is warmed by the afternoon sun and causes delivery to the interior great spaces and to the shaded north end rooms of air so cool as to cause drafts.

The same condition follows in winter if the steam valve on the convector in the private office that holds the thermostat is open. Some of the supply valves on the convectors in other private offices at this moment may be closed and the occupants of these offices complain of chill or go home to bed. At considerable cost (at my behest, in this case) each private office will receive a thermostat and a valve on its convector. The north end air supply duct will receive a booster heater and a thermostat to control the booster, while the general offices will have the thermostat in the general office—not in the private office of a brass hat. Imagine one of those big red ants biting your back under your armor while the only place you can scratch is on your front!

Changes in NFPA Standards for Air Conditioning Reconsidered

THREE SUGGESTED CHANGES in the standards for the installation of air conditioning, warm air heating, air cooling, and ventilating systems of the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass., were referred back to the NFPA committee on air conditioning for further consideration in actions taken at the association's annual meeting held in Chicago the end of May.

It was felt that insufficient data were available to adopt the following, which had been suggested in the air conditioning committee's report presented at the meeting:

In buildings equipped with air conditioning or ventilating systems where removal of smoke is desirable or advantageous for the protection of life or property, the air conditioning or ventilating systems may be designed for utilization in the removal of smoke.

Note: It is recommended that in premises where the panic hazard is pronounced means be provided for manually shutting down the supply air fan of an air conditioning or ventilating system and having the return or exhaust air fan in operation for the removal of smoke by exhausting the air to outdoors.

In hotels, department stores, hospitals, institutions and similar occupancies and multifamily houses having neither air conditioning nor ventilating systems, it is recommended that an exhaust system be provided, in addition to the toilet exhaust, to be manually operated in case of fire and to remove smoke.

The following proposed change was also referred back to the committee:

Corridors and stairways in hotels, hospitals, institutions and similar occupancies and public corridors and stairways in multifamily houses shall not be used as a part of systems for supply of air to rooms or removal of air from rooms.

In part I of the NFPA standards, covering installation of air conditioning and ventilating systems in other than residences, a correction in Fig. 1 to show a pressure relief damper at the top of the shaft enclosing return air duct was approved as was a revision in the first sentence of paragraph 125 to make it read as follows:

No attic, basement, or concealed space in a building shall be used as an integral part of a duct system unless it conforms to all requirements for ducts.

In part II of the standards, covering the installation of warm air heating and air conditioning systems in residences, addition of a new sentence at the end of paragraph 332 was approved as follows:

There shall be no manual disconnect switch in the fan electrical circuit.

This same sentence is also to be added at the end of paragraph 351.

The following suggested new paragraph was referred back to the committee for reconsideration:

In the case of a two-family residence, the public hall, public corridor or public stairway shall not be used as a part of systems for supply of air to rooms or removal of air from rooms.

PUBLICATION OF TWO ARTICLES DEFERRED

Many societies and associations hold national meetings in June. In order to make space for prompt reports of these meetings in this issue, it was necessary to defer two articles which otherwise would have been published this month. These are the second of William Sturm's two articles on Vertical Air Distribution in Tall Buildings, and the next in John H. Clarke's series, Design Engineer Reports on Operating Experience. These will appear later.

AT CINCINNATI

. . . members of the HPACCNA gathered for the 58th annual meeting, among many subjects discussed . . . . . .

Pipe Welding, Business Outlook

PIPE WELDING, particularly as applied to stainless steels, was one of the many subjects discussed at the 58th annual convention of the Heating, Piping and Air Conditioning Contractors National Association, held last month in Cincinnati. The very considerable interest on the part of the 500 odd members and guests registered for the convention in this important subject was evidenced not only by the scheduled committee reports but also by the many questions which were asked from the floor.

During the session which was largely devoted to welding, Richard S. Tobin, chairman of the committee on welding, supplemented the published report of his committee by stating that there had been a good many requests for a stainless steel welding procedure which, as yet, is not available. He stated that the information published by the association and that available from a manufacturer should be sufficient to keep the members out of trouble until the procedure is available.

In discussing the report of the national certified pipe welding bureau, Chairman W. W. Murray, Jr., stated that both the ASME boiler code and the ASA power piping code do not permit interchange of welders. Tests conducted by one contractor do not qualify a welding operator for work with another contractor. A number of conferences have been held in the hope that revisions will be adopted to make possible the interchange of welders for high pressure pipe work within the classes of jobs for which the welders are qualified.

Must Qualify Welding Procedure

Enlarging on the published report of the editorial committee for the standard manual on pipe welding, Chairman John H. Zink said that the revised manual is not yet finished but should be ready for distribution this year. The stainless steel chapter, he said, has been most difficult as the problems are not confined to just welding. The many different types and specifications of stainless steel pose standardization problems. He warned the contractors present not to assume the responsibility for corrosion, etc., and to seek the advice of the association before going ahead with piping jobs of this material because of the many complex factors. Mr. Zink also discussed the complications in qualifying welders. The various inspection companies, he said, such as the Hartford Steam Boiler Inspection and Insurance Co., are not interested in certifying a welder as such. The contractor must submit his procedure which is tested with his operator. The operator that the contractor uses is automatically approved with the procedure. If the welder changes jobs, he loses his qualification and must again qualify with his new employer's procedure. Mr. Zink has a welder who has qualified 12 times on 14 different jobs. The answer to this, he said, is a certified welding bureau. He recommended that contractors use the association's procedure as their own procedure because this would then qualify the welder for that procedure and would result in some uniformity. He also pointed out that the association's procedure is in accordance with the ASME boiler code.

Preprints of chapter 4 of the second edition of the association's standard manual on pipe welding, dealing with estimating costs of welding pipe, were passed out and were discussed by Mr. Tobin, who pointed out that in order to use the data, the contractor must first determine the length of time necessary for his welder to deposit the

weld metal in butt welds in 4 in., Schedule 40 pipe. Multiplication factors are then used to determine the welding costs for this and other sizes of pipe.

After the conclusion of the committee reports, which had covered various phases of welding, many questions were put to the three chairmen from the floor. George P. Nachman, of Spohn Heating and Ventilating Co., asked about a welding procedure for copper-silicon alloy pipe and was told by Mr. Tobin that there was none available as the demand had not been sufficient for this and a number of other special alloys. In response to a question from Roy M. Getschow, president of Phillips Getschow Co., and outgoing president of the association, Mr. Zink supplemented his remarks about qualifying welders and in so doing remarked that pipe welding constitutes about 12 to 15 per cent of all welding done in the country, yet 90 to 95 per cent of all regulatory welding controls affect pipe welding.

In regard to testing welders, Mr. Tobin called attention to the fact that there are some good welders who often cannot pass the tests. His advice was to set up the test specimen, etc., in such a way that the welder could have a chance to practice and to get over any nervousness. It is important, he said, to convince the operator that you are trying to help him. Mr. Zink remarked that sometimes faulty ammeters are the cause of test failures.

Mr. Nachman rose to say that he thought it important that the testing be done on the operator's time and that the union should agree to this. He pointed out that this arrangement has been in effect in Chicago for some time. Mr. Zink agreed and indicated he thought it a good idea to have the union request the shop facilities in writing.

The use of backing rings for oxyacetylene welding was brought up by a contractor, and Mr. Zink stated that he thought they were ideal for this type of welding. He expects such rings to be on the market in the near future. At this point another contractor hastened to state that in qualifying his procedure and welders, backing rings were not permitted. The fact that the boiler code permits rings to be used was mentioned by Mr. Zink, who regretted the discrepancy in the inspector's directions.

Describes Stainless Steel Pipe Welding

Next on the agenda of the welding session was a talk on welding stainless steel piping by J. D. Mattimore, chief engineer, product engineering and research, Tube Turns, Inc. Before launching into the details of welding, he reviewed some of the common applications of stainless steel pipe, such as in sanitary piping used for food handling, where chemical processes make it mandatory that contamination from the piping be eliminated, where prevention of corrosion is necessary, where extremely high or low temperatures are encountered, and where fluids, such as hydrogen, at elevated temperatures and pressures might cause embrittlement.

While there are approximately 30 types of stainless steels on the market, Mr. Mattimore said that only three types have found common use in piping systems. These are designated by the American Iron and Steel Institute as AISI types 304, 316, and 347. Each type is of the 18 per cent chromium—8 per cent nickel analysis, but in the case of 316 approximately 2½ per cent molybdenum is added to improve the corrosion resistance under certain conditions and to improve the strength at high temperatures. Type 317 differs from type 304 only in that 0.7 to 1.0 per cent columbium is added to reduce the tendency for carbide precipitation to occur.

In describing the various types of welding processes, Mr. Mattimore said that all of the manual welding processes, including oxyacetylene, shielded metallic arc (both a-c and d-c), inert arc, and atomic hydrogen arc welding have been successfully applied to stainless steels. While the direct current shielded arc and the oxyacetylene methods are most common for stainless steel in the iron pipe sizes, considerable interest is being shown in inert arc welding using helium or argon as the shielding medium. In giving detailed recommendations as to welding procedure, he said that cleanliness is vital and that all

IN SPITE of hot weather, high humidity, and a somewhat faulty hotel air conditioning system, the 58th annual convention of the Heating, Piping and Air Conditioning Contractors National Association, held last month in Cincinnati, was a lively, enjoyable, and well-attended gathering. As evidenced by attendance at the sessions and the questions asked from the floor, interest was sustained throughout the meeting in such subjects as radiant heating, apprenticeship training, pipe welding (especially stainless steel), and the general business outlook. The discussions on pipe welding, the talks dealing with the business outlook, and several committee reports are covered here. Other topics of the meeting will be reported in a second installment.

---

foreign substances, especially carbonaceous substances such as oil and grease, should be removed from the welding area. If the pipe has been hot worked, the oxide film must be removed, and if wire brushes, steel wool, or grinding wheels are used, great care must be taken to prevent particles of carbon steel being embedded in the pipe metal. This means that the wool and brushes should be made of stainless steel, and any grinding wheel which has been used on carbon steels should not be used.

Edge preparation is also considered by Mr. Mattimore to be important. He recommended 37½ deg beveled butt joints in preference to square butt joints, at least down to wall thicknesses of 0.083 in. Also stressed was alignment, which, he said, must be exact with jigs used wherever feasible. After alignment, tack welds should be used and should have only slight reinforcement.

Though metallic arc welding is probably the most suitable method, it is not easily accomplished on light gage work, according to Mr. Mattimore. In fact, he believes that for wall thicknesses less than ⅛ in. the inert gas method seems to offer the best possibilities. The disadvantages of this latter method are that it requires a fairly exacting tech-

nique and since the inert gas leaves the torch at a low velocity, outdoor welding may be difficult because of wind blowing away the shield. In addition to stating that reversed polarity should be used for direct current, shielded metallic arc welding, he stressed that molten stainless steel flows more freely as compared to carbon steel so that a faster welding speed is required.

The audience was urged to make sure that a neutral flame is used when welding stainless steels by the oxyacetylene method as too much acetylene will result in carbon absorption, with resultant loss of corrosion resistance, and an excess of oxygen will result in an oxidized and unsound weld deposit.

In conclusion, Mr. Mattimore said that one of the greatest problems is the selection of the proper type of stainless steel for the job at hand. No one, he said, should take the responsibility for the proper material being used except the customer and complete understanding between the customer and contractor is essential.

Business Outlook Forecast

In his talk on the outlook for business, Dr. N. R. Whitney, economist, Procter and Gamble Co., briefly outlined some of the factors which are now setting up stresses and strains in the country's economic life and discussed their probable effects. With current employment at over the 57 million level, the shortest working hours, the highest wage rates, highest prices, and greatest business profits in history, we are in the midst of a boom. However, such factors as the scarcity of labor, the freight car shortage and the slowness of loading and unloading, shortages in raw material and the semi-finished goods, the growing scarcity of capital, rising prices in all things, the current production ratio of durable to consumer goods, and the export-import distortion all add up to stresses and strains which, he said, point to economic change. Some of the signs to be noted are that pipelines are filling up, sales of luxuries are slipping, inventories are being lowered, scrap markets are weakening, and construction is down about 30 to 40 per cent. From an economist's viewpoint, he believes we have a menacing farm, economic,

Welding high pressure steam piping

labor, and foreign situation, coupled with burdensome taxes.

While the demand for goods is still with us, prices and uncertainties are slowing things up. The outlook for the labor situation is improved. These and other factors, in Dr. Whitney's opinion, point to a fairly mild recession—beginning about the middle of this year and reaching a 30 per cent reduction in industrial activity and prices around the middle of next year. Starting with a return to a more prosperous level around the middle of 1948, Dr. Whitney expects a gradual upturn to reach a peak in the middle of 1949, at which time we should be on a sound economic basis for some years—barring international complications.

N. P. Mason, president, National Lumber Dealers Association, in his talk on What About Building, drew attention to the many questions being asked by the public in regard to building costs, availability of materials, and the lack of homes for the veterans. Recognizing that these questions are only natural, he said that it is important that everyone connected with the construction industry should go out and tell the "truth" to the public. He urged that the members in attendance tell how government red tape, rent ceilings, restriction orders, etc., are tying up the industry and are resulting in nationwide law breaking.

Mr. Mason said that the material situation is improving and that while building prices are too high, they are coming down as a result of the supply and demand, but they cannot go below the general price level. Stating that most people think of construction costs in terms of prewar levels, he compared building cost increases with commodity prices, farm prices, and various income group increases to clarify his point that building costs are not way out of line.

Committee Reports Discussed

The report of the Plumbing and Heating Industries Bureau was given by Arnold H. Goelz, Kroeschell Engineering Co. Pointing out that the general press looks to the bureau for information on such popular subjects as radiant heating and the heat pump, he stressed that the present level of activity in this field will not last indefinitely and recommended that a program be inaugurated which would promote good will with the general public.

The talk by Henry J. Wallace, general manager of sales, National Tube Co., on the steel pipe situation was an off-the-record discussion which proved to be of great interest to the many members in attendance. Mr. Wallace sees no improvement in the procurement situation of steel pipe for quite some time.

No Undersized Boilers Reported

The reports of the boiler output committee and that on the American standards association were given by Chairman Harry M. Hart. Regarding the boiler output committee, Mr. Hart said that no failures of heating plants due to undersized boilers were reported to the committee during the year. In discussing capacities for radiant heating systems, he pointed out that where boiler selection is based on installed heating surface, it is only natural that the boiler will be oversized for the job if the panels are oversized. Supplementing the published report of the American Standards Association, Mr. Hart called attention to the fact that a joint committee representing the U. S. Department of Commerce and the ASA are actively engaged in a study of standardization in the field of consumer goods, especially in relation to building codes.

R. E. Ferry of the Institute of Boiler and Radiator Manufacturers

supplemented Mr. Hart's report and stated that most large boilers above 40 in. grate width do not have IBR ratings. With one or two exceptions, he said, these larger boilers will be tested and rated. George P. Nachman, of Spohn Heating and Ventilating Co., asked for information on the boiler and radiator delivery situation, and in reply Mr. Ferry cited bottlenecks such as the pig iron and scrap situation and somewhat improved labor relations. He believes the industry will produce 250 to 275 million pounds of boilers this year as compared to 300 million pounds in 1941. He also stated that about 60 million sq. ft. of radiation would be produced this year as against 40 million last year and 75-80 million in 1941.

VHP-1 Still in Force

In mentioning the published report of the committee on air conditioning, Chairman A. C. Buensod made a plea for the return of empty "Freon-12" cylinders. He stated that the manufacturer hopes to supply all legitimate demands for this refrigerant made during this summer but hastened to add that the shortage of cylinders has been a bottleneck. He pointed out that the manufacturer's new policy permits anyone to return empty drums directly to the factory for credit. A letter from Housing Expediter Frank R. Creedon was read, and the members noted that Mr. Creedon suggested that it would be well to point out that Veteran's Housing Program Order 1 (VHP-1) also restricts the making of alterations to a building or other structures covered by the order in connection with the exempt items, such as air conditioning equipment required to provide humidity or temperature control for industrial processing and self-contained units. Supplement 4 to this order also provides that the restrictions apply to work on structures built or used in connection with cooling towers and electrical precipitators or to work on structures which is made necessary by work on such items. In view of recent developments in the House of Representatives and the many newspaper articles concerning the possible end of VHP-1, both Mr. Buensod and Morgan Williams of the Cincinnati office of the Housing Expediter emphasized that the limitation order is still on the books and warned against jumping to conclusions in regard to any revocation. Mr. Williams urged the contractors to consult with the local offices of the Expediter.

Pipe fitting apprentices at the Washburne Trade School, Chicago, learn the techniques of welding

NEW HEAT TRANSFER DATA FROM WARTIME STUDIES

THERE IS RELATIVELY little significant new heat transfer data applicable to oil burner development which has emerged from the war. The most important contributions now available (that is, unrestricted) are those of L. M. K. Boelter and his associates of the University of California. A number of these were recently issued as NACA (National Advisory Committee for Aeronautics) Wartime Reports. There is quite a series that have some bearing upon oil burning and air conditioning and other heating units. They are identified as NACA Wartime Reports W-8 to W-25 inclusive. They are concerned principally with the development of aircraft heaters. There is quite a bit of fundamental data on properties of gases and various forms of heat exchangers.

Also, George Reuter and his associates at the Cleveland engine laboratory of the NACA, have issued some interesting reports on heat exchangers. Two of these are Wartime Reports Nos. E-97 and E-106. They have to do with gas-to-air heat exchangers and intercoolers.

In aircraft gas turbines and jet engines heat transfer is a relatively minor factor, involved primarily in the cooling of certain of the parts—notably the combustion chamber liners. The heating of the jet gases is accomplished by direct mixing of air with the combustion gases.

By all odds the most interesting and pertinent features of jet engines are the combustors and the new combustion data obtained in their development. How much of this can be applied to domestic and industrial oil burners to advantage is very questionable, but there is no doubt that some interesting possibilities have been uncovered. I am sure we are going to find a lot of these developments rather stimulating, if nothing else, although I think that some very useful and pertinent applications may be derived from them. For example, it is now common practice to burn kerosene, gasoline, or No. 2 fuel oil at heat release rates up to 15 million Btu per hr per cu ft, with combustion efficiencies of 95 per cent or better. A. J. Nerad, General Electric combustion expert, has calculated that, at this rate, enough heat could be generated within a 30 ft cube to run all of the electric generating plants of the United States.

—from a talk by Prof. W. J. King, director of the Sibley school of mechanical engineering, Cornell University, at the convention of the Oil-Heat Institute.

Refrigerating Engineers Hear Two Talks on Panel Cooling

Refrigeration Uses in Movie Labs, for Growing Plants, Evaporative Condensers, Air Flow, Also Discussed at Spring Meeting of ASRE Held Last Month in California

JUNE WAS "air conditioning month" in Southern California, for —following the semi-annual meeting of the American Society of Heating and Ventilating Engineers at Coronado—the American Society of Refrigerating Engineers opened its spring meeting in Los Angeles with a technical session featuring two papers on panel cooling and a discussion of refrigeration in motion picture laboratories. Among the subjects of the papers presented at subsequent sessions were the use of refrigeration and air conditioning in the growing of plants, evaporative condenser design and water treatment for scale control, and laboratory air flow measurement.

In his paper on the mechanism of heat transfer, panel cooling, and heat storage, Charles S. Leopold (consulting engineer and a member of HPAC's board of consulting and contributing editors) reported on an investigation the laboratory work for which was financed by the publishers of Time, Life, Fortune, and Architectural Forum. It is understood that this paper is the first of a series of several contemplated by Mr. Leopold on the subject of "radiant cooling."

In his introductory paragraphs, the speaker pointed out that an understanding of actual peak loads, heat storage of the structure, feasibility of zoning a multiroom structure, selection of controls, etc., require fundamental analysis of the various mechanisms whereby energy sources receive or impart their energy in a room and its air and water vapor content. The author claims that the concept of overall surface conductance is inadequate for panel cooling analysis.

In approaching the engineering problem of panel cooling, Mr. Leopold stated that a prime consideration is the danger of condensation on or within the cooled panel, and that this has done much to retard the development of this method. He then pointed out that the fact that a large portion of the radiant energy of a luminaire lighting fixture transfers directly to a structure by radiation is of great importance because, first, the portion of the radiation which is directly absorbed by a cooled ceiling panel can be carried away without depressing the panel surface below room air temperature, and (second) because the radiation absorbed by the other room surfaces tends to raise their surface temperatures and thus facilitates transfer to the cooled ceiling by radiation.

A test cubicle used in the investigation had aluminum cooling plates in the ceiling, and a similar plate in the floor beneath 1 in. of insulating board to eliminate transfer through the floor. The walls were constructed of steel reflective insulation backed by insulating board.

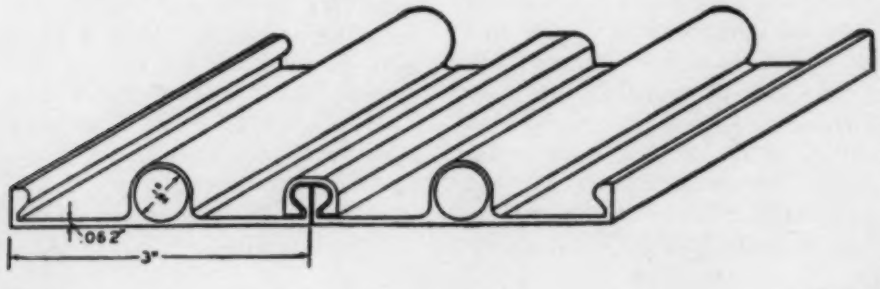
In concluding his talk, Mr. Leopold said that there are many economic problems in the application of panel cooling to true air conditioning but that it appears that the design problem of accomplishing the required work without getting dangerously close to the room dew point can be readily solved where the major load is due to lighting.

The complete paper has been preprinted by the ASRE, 40 W. 40th St., New York 18, N. Y.

In a companion paper (also preprinted by the ASRE and the experimental work for part of which was also financed by the Time-Life-Fortune-Architectural Forum publishers), Carl F. Kayan, Columbia University, reported on temperatures and heat flow for a concrete slab with imbedded pipes.

Cooling of an enclosed space through the use of a floor slab containing imbedded pipes involves heat transfer through both ceiling and floor surfaces, he pointed out. For a given construction and pipe to air temperature difference, the magnitude of the heat flow and the variation of slab temperatures depend on pipe size and spacing, material conductivity, and the value of the net or effective surface conduc-

Section of aluminum cooling plate used in test room for studies on panel cooling



tance, said Professor Kayan. The effects of some of these different variables have been investigated through the method of electrical analogy and were reported in his paper. An alternate method of determining temperature distribution by computational methods was likewise presented.

Results were given in terms of surface conductance comprising both convection and radiation components. The significance of these was brought out in the above mentioned Leopold paper.

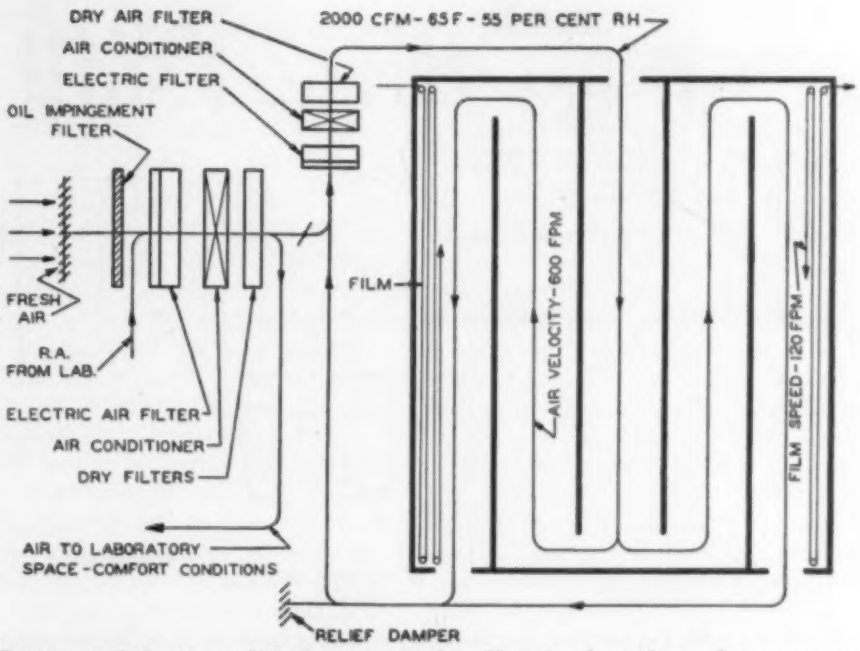
Movie Labs Need Refrigeration

In a very practical and straightforward discussion entitled Movie Labs Need Refrigeration (published in the June journal of the ASRE), Arthur J. Hess, of Hess, Greiner and Polland, classified refrigeration in motion picture laboratories as that used in the film developing process and that for the process air conditioning necessary in the proper operation of the laboratory.

The developing process is a combination of chemical baths, fixing washes, water rinses and drying; unless counteracted, the heat generated will change the temperature of the developing solutions and affect the quality of the finished film. Refrigeration consists of a water chilling unit to provide the chilled water for the heat exchangers through which the developers are circulated. A typical laboratory with four double developing machines utilizes a 25 hp "Freon" condensing machine to chill water in a shell and tube water chiller of conventional design, he said, with a 500 gal storage tank for standby. The temperature range is in the neighborhood of 60 to 70 F.

The air conditioning problem essentially is to dry the films as rapidly as possible, Mr. Hess stated, with the relative humidity of the drying atmosphere maintained during the process in excess of 55 per cent to prevent accumulation of static electricity on the film. Because high temperatures would damage the emulsion and distort the film, the atmosphere is maintained at approximately 65 F.

A further factor involved is air cleanliness, as an air velocity of around 600 fpm is maintained over the film surfaces to remove the water vapor as fast as it is evaporated. Modern electrostatic air cleaners give the desired efficiency, according to Mr. Hess, but great care must be given to proper installation to prevent sparking. Good practice calls for supplementary filters—usually an oil impingement type preceding the electrostatic units and a dry type following it.



Recommended air conditioning system for film dry box, from the paper on refrigeration uses in motion picture laboratories

Air Conditioning for Plant Growth

F. W. Went, professor of plant physiology at California Institute of Technology, said that successfully air conditioned greenhouses have been in operation for some years and sufficient information is on hand to indicate what importance air conditioning and refrigeration may assume in the future growing of plants; his paper was published in the June journal of the ASRE. He reviewed the day and night temperature requirements for various plants, and the light needed, showing illustrations of tomato, corn and lettuce plants grown under different conditions.

The speaker remarked, in conclusion, that it can be stated positively that possibilities exist along the line of greater environmental control of plant growth, and that the next step is for growers and engineers to become interested in the development of suitable methods by which such environment control can be accomplished most economically. Each crop will have its special requirements and may involve a special solution. Whereas the bulk of plants will continue to be grown without the benefit of environmental control, by merely fitting their requirements to existing climates, there is no doubt but that there will be an increase in the number of plants grown under more or less controlled conditions, and that this control will be more positive and will include refrigeration—especially in warmer climates.

Preventing Scaling of Condensers

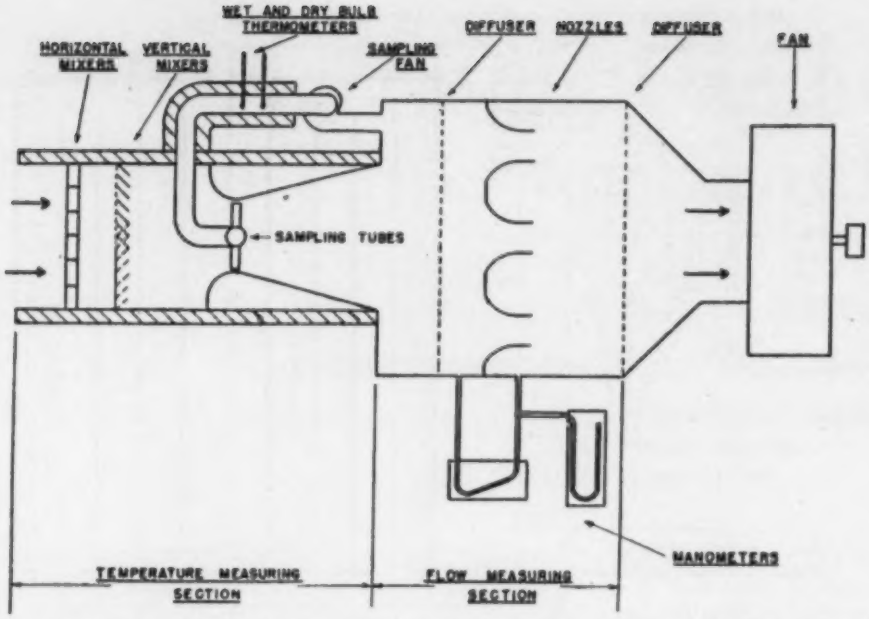
Eight elements of design of evaporative condensers have a direct influence on scaling and fouling of this equipment, according to Ralph M. Westcott in a paper on evaporative condenser scale control, which was preprinted by the ASRE:

1) Rate of water circulation should be high compared to evaporation rate; this provides washing action.

2) Even water distribution over the condensing surface provides uniform washing action.

3) Design and location of the spray header and nozzles influence water distribution, erosion, and entrained moisture loss.

4) Condenser tube bundle design influences water and air circulation



Improved multiple nozzle apparatus for air flow measurement in the laboratory

and distribution. (Fin spacing should be at least equal to the height of the fins and the spacing between the finned coils should be at least equal to the height of the fins, according to Mr. Westcott.)

5) Superheat elimination apparently improves scaling factors.

6) Corrosion limits the life of an evaporative condenser as much as any other single factor of deterioration.

7) Disadvantages of subcooling —such as having the valves and connections always in a water bath, and inaccessibility of the pan for cleaning and painting—"far outweigh" the possible advantages.

8) Accessibility is the "last but not least" design element necessary to keep an evaporative condenser clean.

Scale control by water treatment may be accomplished by one or a combination of two broad methods, he stated: external or pretreatment of the water before it goes to the heat exchanger, usually accomplished with zeolite softeners, filters, or chemical treatment to remove scale forming salts and entrained solids; and internal chemical water treatment.

When adequate water treatment coupled with good design has not been provided, and the evaporative condenser becomes scaled, there is only one practical method of descaling and that is by use of an inhibited acid, he concluded. An inhibitor is usually an organic material which is added to the acid (muriatic or hydrochloric) to inhibit the action of the acid on the metal.

Laboratory Air Flow

Air flow measurement in the laboratory was the subject of a paper by D. D. Wile, Carrier Corp., published in the June journal of the ASRE.

The practice in most air conditioning laboratories is to measure air flow by means of orifices or nozzles, nozzles being generally preferred. In the past, recommended procedures for the installation of nozzles has required equipment that was inconveniently large. As a result of the work described in this paper, several improvements in technique have been made: size of the equipment has been reduced without impairing accuracy; method of measuring the temperature of air stream leaving an air conditioning unit or coil has been improved; and data have been made available on the application of perforated plates to air measuring equipment. Information on the resistance of perforated plates, nozzle discharge coefficients, and factors affecting nozzle performance was presented in the paper.

An extensive discussion of mineral lubricating oils, by Edgar S. Rose, of the Sun Oil Co., covered their derivation, production, properties, and use in refrigerating systems.

NEW CANDY PLANT AIR CONDITIONED

A typical example of how air conditioning and refrigeration are becoming increasingly important in the candy industry is the $1,000,000 plant of the Walter H. Johnson Candy Co., Chicago, to be placed in operation this summer, says the Refrigeration Equipment Manufacturers Association. The factory will be used for increased production of candy bars and other types of confections.

The plant is air conditioned throughout, from executive offices to candy wrapping rooms. Containing 100,000 sq ft of space, the factory is divided into four separate sections—each with temperatures and humidity conditions regulated in accordance with the operations performed within the section. For instance, conditions for different sections range from 60 F with 45 per cent humidity to 80 F with 50 per cent humidity.

Four systems capable of operating singly or in combination with one another as conditions demand provide the necessary cooling, heating, filtering, and humidifying of the air supplied to the four sections. Each section has an individual air circulation system because of the varying temperature and humidity conditions required and to prevent transmission of odors or foreign matter from one section to another.

A temperature of 80 F with 50 per cent humidity is provided for the executive offices, conference, and miscellaneous rooms. The same temperature and humidity are maintained in the section wherein fudge is prepared.

A temperature of 60 F with 45 per cent humidity is maintained in the section where "Powerhouse" candy bars are made. Direct expansion coils are used in this section to maintain proper temperatures within the enrobing tunnel where candy with chocolate coated centers is cooled. Water from city mains is chilled and is used throughout the rest of the plant.

Refrigeration is also used to chill the water used in the candy "slabs," the large metal tables upon which candy is allowed to cool following its preparation in the kitchens. Chilled water at 35 F is used to maintain a table surface of 37 F.

"OPEN FOR DISCUSSION"

FOUNDRY VENTILATION

I HAVE READ WITH interest the discussion on Foundry Ventilation by Messrs. Black and Avery in the April issue. I do not know whether the following comments are of appreciable interest or add anything to their discussion:

The method of ventilation of the pouring station is certainly of interest and I would like to see a hood sketch of the supply and exhaust arrangements. It is always a rather tough problem of preventing contaminant escapement from a hood when the supply air is of the same volume as the exhaust system. Normally we would have anticipated that an exhaust volume of 15,000 cfm would have placed an upper limit of 10,000 cfm on the supply air system in the vicinity of the suction hood. Supply systems of this type can frequently be tempered by bringing in a small amount of room air through a bleed damper in the supply stack operated by a thermostat. Such a device would have eliminated the difficulty from too cold supply air during extreme low temperatures.

The author's experience on exhaust requirements for a pouring hood could be more easily interpreted if the 15,000 to 200,000 cfm figures were translated into "cfm per foot of pouring hood length."

FOUNDRY VENTILATION

Jim Black and Lee Avery Suggest How to Plan for Good Conditions

It is interesting to note that the downdraft system for the casting shakeout proved effective, as many attempts to provide shakeout exhaust by this method have proved unsatisfactory both from the standpoint of dust control and the difficulty of excessive pickup of usable sand with the exhaust air.

It would be interesting to amplify the last sentence in the article, as the wording implies that exhaust volume must be increased from 73,000 to 120,000 cfm without variation in hood design—the exhaust volume increase being caused by an increase in the size of the casting. Exhaust volumes, at least for the dust control phases of the operation, should be a function only of the hood openings as invariably the volume of air exhausted will not vary with the amount of dust generated but rather with the hood design and the indraft velocity required to prevent its dispersion to the workroom.—JOHN M. KANE, dust control div., American Air Filter Co., Inc.

TESTING AND RATING FUEL OILS

THE PROPOSED method of testing and rating fuel oils by smoking tendency, as described by G. T. Kaufman on page 78 of the May HPAC, marks an important step toward more rational bases for establishing the burning characteristics of fuel oils. The industry has for much too long a period of its history been hampered for want of methods more concise and meaningful than the conventional physical and chemical tests such as specific gravity, volatility, residue, etc. Mr. Kaufman implies that necessity for the new testing technique arose through the differing characteristics of the present-day catalytically-cracked fuels, which is in the way of an understatement; the need is now more urgent, but much good could have been derived from more adequate testing methods of even the older thermally-cracked products.

Another and very cogent reason for instituting more rigid tests of fuel oils is the rather broad spread in limits set up by the commercial specifications, especially in the heavier grades. From a manufacturer's or distributor's point of view, there is considerable advantage in being able to offer products that do not have to conform to close limitations of specifications but to the burner man and the ultimate consumer, close specifications are most desirable. It remains for the oil burner industry to decide which specifications are the important ones.

Smoking tendency undoubtedly has significance in evaluating a fuel oil. Mr. Kaufman is referring to domestic grades, and he mentions specifically the deep interest of the vaporizing burner man. It is well that he should. The vaporizing burner can consume smokelessly only those fuels that have good volatility. The latter property also implies reduced tendency toward carbon deposit, which is the chief problem of the vaporizing burner, aside from soot formation.

But to test the smoking tendency of an oil, it is proposed by the Oil-Heat Institute to perform the combustion with a pressure atomizing burner. The properties that make a good fuel for a vaporizing burner may not be controlling factors when the oil is mechanically atomized under pressure. The vaporizing burner needs a fuel that will volatilize readily and leave no carbon residue; the pressure atomizing burner needs a fuel that can be mechanically subdivided into minute droplets. In the second case, such properties as viscosity and surface tension come into play.

The proposed testing apparatus is a water cooled cylinder with movable back wall, presumably to allow variation in combustion volume. This leads one to ask what basis of combustion volume will be used in the test. Furthermore, while a water cooled cylinder may simulate a boiler, in many installations the oil is burned in a refractory firebox, not in the water cooled

Smoking Tendency Determines Burning Oil Performance

space above the firebox. It is, of course, more than probable that if an oil can be burned smokelessly under the conditions imposed by the proposed test, it will burn smokelessly in a refractory firebox also. But the test environment may cause rejection of oils that might be quite suitable under the conditions of actual use in a refractory firebox.

The present commercial specifications of fuel oils were promulgated jointly by the Bureau of Standards and the American Society for Testing Materials. Surely these two agencies should also be party to any proposed new method for testing fuel oils, even granting that up till now the commercial specifications have allowed broad variation within the permissible limits.

By coincidence, the current issue of the ASTM Bulletin contains an article on this same subject: A Burning Index for Distillate Fuels. Its authors, J. C. Reid and A. B. Hersberger, present data already accumulated showing that smoking tendency is related to the 50 per cent boiling point of a fuel oil. Here an attempt is made to correlate new methods with previously established facts. The method was tried out and its results have been plotted to establish that some insight into oil properties might be gained from study of smoking tendency. These experiments are stated to have been made on domestic rotary burners, where again volatility is the prime characteristic that affects combustion. Thus far no one seems to have approached the problem from the viewpoint of mechanical atomization, despite the fact that by far the greater amount of fuel oil sold is consumed by burners using some type of mechanical atomization rather than vaporization by heat.

It is to be hoped that further studies by means of the proposed OHI apparatus will correlate smoking tendency with such oil properties as viscosity, density, and surface tension, as well as to volatility, and that the reported data will include information on effect of nozzle design, atomizing pressure, combustion rate, and environment temperature. — KALMAN STEINER, C. Hoffberger Co.

GAS FLOW FROM STEEL STACKS

SAMUEL R. LEWIS' very practical comments are always interesting and informative. However, there would seem to be considerable grounds for argument concerning his explanation of gas flow from round steel stacks on pages 94-95 of the April issue.

I have never taken a pressure reading on such a stack during a high wind, but a theoretical analysis would indicate that the wind would cause an aspirating effect and that this effect would increase as the wind velocity increased. Thus, theoretically, there would never be the condition he indicated when "the wind cuts off the gases almost as efficiently as if it were a damper." I have done a small amount of research work on a model steel stack and the data obtained are in support of my theoretical analysis, although such data could be misleading.

Secondly, Mr. Lewis explained that the pressure inside a stack becomes greater than atmospheric when a high wind is blowing. If this is true, then it is obvious that flue gases would be blown back into the boiler room under such circumstances and, to my knowledge, no such trouble is normally experienced with a properly located stack.

In explanation of the leakage of smoke through joints in the stack during a high wind, I would expect this to be the result of the low pressure area on the leeward side of the stack. This low pressure area will always result on the downstream side of an object over which air is passing, and the negative pressure produced will be a direct function of the air velocity. Hence, with a sufficiently high wind velocity, the pressure on the leeward side of the stack will be more negative than the pressure of the flue gases in the stack and gas will flow outward through the joints.

It would be interesting to know what actual draft gage readings have been taken on a round steel stack during a high wind by Mr. Lewis or any of HPAC's readers.— I. A. NAMAN, consulting mechanical engineer.

REPLY BY AUTHOR—Mr. Naman admits that he has seen smoke emerging through the joints on the leeward side of a straight steel stack in a strong wind. He thinks that this emergence is due to suction rather than to pressure within the stack caused, as I suggested, by a plain stack finial.

I admit that the emergence of the gases through the joints is due to a higher absolute pressure within the stack than that existing on the outside of the stack on its leeward side. I think Mr. Naman will admit the same thing.

I do not think that the leeward-emergence will be as marked on a bell top stack as on a plain top stack. I have done research on models of various chimney tops and ventilators. This research indicated that a plain uplooking outlet generally is more effective than any hood or cowl.

I have not any records of draft gage readings on full size round steel stacks taken during a high wind. However, all chimney designs emerging from this office will endeavor to include means for promoting the ejector effect of high velocity currents across the leg of a tee, such as is exemplified by use of Y fittings rather than T fittings in water piping.—SAMUEL R. LEWIS, Samuel R. Lewis and Associates, engineers.

PIPING FLEXIBILITY ANALYSES

An error in sign appeared in the third line of the second column on page 71 of the May issue of HPAC in the article on Methods of Making Piping Flexibility Analyses, by H. V. Wallstrom. The author states that $-(s_b/s)$ should read $+(s_b/s)$.

DATA SHEET Simplified Procedure for SPECIFICATION WRITING

In the April 1946 Heating, Piping & Air Conditioning there was an article entitled A Simplified Procedure for Specification Writing, by George W. Campbell. Due to several requests, it was decided to run as a supplement to this article a series of specification cards which are currently being used by the firm of Urdahl and Everetts, consulting engineers, in their Washington, D. C., and San Francisco offices. Mr. Campbell is presently employed in the Washington office.

The cards have been duplicated by the "Ditto" process. After the original duplication on 8½ x 11 in. paper, the copies were cut into 5 x 8 in. cards. The "master" ("Ditto" terminology) was also cut out and filed in a 5 x 8 card file. The original cards have no dates. As the cards were revised, a date was added so that an obsolete card would not be used.

The cards are in two sections, a lettered series and a numbered series.

Let us assume a specific problem. We have designed a direct fired air conditioning system. We would go to the files and remove card No. A. Looking under paragraph 1, we note general intentions, scope of work, and time of bids. These items should be written on a 5 x 8 in. card or paper and should be given the numbers noted.

Consulting engineers and architects usually have a permanent set of conditions which they use for the particular locality in which they work covering such items as checking, definitions, delays and extensions, and accompanying drawings. These are included in paragraphs 2-31 indicated as printed matter; if we do not want to use 30 paragraphs for this material we can easily change the number.

Paragraph 32, work to be done by others, is another paragraph that will have to be written out for each job as every job will be different.

We now have arrived at the part of the system that is a time-saver. We go through the file and pick out all cards having numbers which are listed on Card No. A, following the title of the specification as direct fired air conditioning unit (1), heat exchanger (9), oil burner (11), etc. In our particular problem we won't need some of the cards. Let's assume we are not responsible for the domestic hot water system, which in this case is a plumbing job; therefore, we return card No. 39 (domestic water heater). Again, let us say the architect is to include in his specification all flashing where it is needed; therefore, we return card No. 34 (flashing).

We now take the cards and number them. Paragraph 33 of our specification will be given to direct fired air conditioning unit (Card No. 1), paragraph 34 to fuel oil tank (Card No. 23), etc. Should any of the cards now become separated, that loss will be easily detected when the secretary starts to type them.

After all the cards have been properly marked for the conditions of the particular job, we turn them over to the typist. After typing, the cards can be stapled together and placed in the job file.

The principal advantage of the system is that the engineer is saved time by not having to write out each specification every time it is desired to specify that item, and it eliminates errors which result from trying to transpose longhand. An added advantage is that an individual specification can be changed by substituting the newly written specification using the old number in place of the obsolete cards.

Cards A, B, C, E, F, G, and 1 were published last month; others will follow. Because of space limitations, they are shown smaller than the 5 x 8 in. size. These specifications are not to be construed as recommendations to other consultants but to illustrate this card file used by Urdahl and Everetts.

(water and steam coils - cleanable headers)

The _____ coils shall consist of seamless copper tubes bonded securely to nonferrous extended surface fins by either expanding the tubes or by an electro-thermal bond process. The copper tubes shall be rolled into close grained cast iron headers in a manner to insure a tight and permanent connection between the tubes and the headers. The header shall be so arranged that access may be readily obtained for cleaning. No solder or brazed joints shall be used in the construction of the coil which shall be capable of withstanding at least 300 psig of air pressure while submerged under water without evidence of leaks. The coils shall be designed for operation with water steam as the heat transfer medium.

Card No. 2
Job No.___

AIR CONDITIONING UNITS: Furnish and install an Air Conditioning Units on each the _____ floors in the manner as shown on the plans. The units shall consist of a fans, humidifier, cooling coils, heating coils, face and bypass dampers, and filters as hereinafter specified and complete within a single sheet metal _____ housing.

This These units shall be the standard product of one manufacturer, completely factory assembled as a unit in a metal housing rigidly constructed and insulated with the thermal equivalent of one inch of rock wool to insure quiet operation and to meet the requirements of the National Board of Fire Underwriters and authorities having jurisdiction in this locality.

The motors for the fans shall be mounted on an adjustable sliding base of the approved type. They shall be wound for ___ volt, 60 cycle _____ phase current _____.
(direct expansion coil)

The cooling coils shall consist of seamless copper tubes bonded securely to nonferrous extended surface fins by either expanding the tubes or by an electro-thermal bond process. The return bends shall be of copper brazed with a high silver content solder. The refrigerant shall be distributed to and gathered from the coil through seamless copper headers brazed with a high silver content solder. The coils shall be designed for operation with "Freon 12" _____ as the refrigerant.

(over)

Card No. 3
Job No. __

___ AIR WASHERS: Furnish and install an Air Washers of the approximate size and in the locations shown on the plans, complete with a pressure gages, thermometers, sprays, eliminator plates, make-up water valve, a light, overflow and drain, access doors, strainers, and accessories. There shall be ___ banks of sprays and two banks of eliminator plates, one on each end of the washer. The light shall be of waterproof design and shall be recessed in the top of the washer in such a manner that it will be cooled by room air. The strainers shall be of the jointed removable type. The access doors shall be of adequate size to permit a man to enter. The make-up water float shall be of the external type similar to boiler make-up valves. The washer is to have a ____ inch quick fill with the valve on the exterior and a 3/4 inch hose bib on the interior of the washer for cleaning the washer.

The interior of the washer shall be painted with two coats of a waterproof corrosive resistant paint after installation. The washer shall be constructed of Galvanized Iron _____ with a 3/16 inch ____ welded steel concrete _____ tank.

The washer shall have the capacity to cool _____ cfm of air from ___ F db ___ F wb to ___ F db ___ F wb, using ___ gpm of water entering at ___ F. It shall have an air pressure drop of not to exceed 0.25" _____ water pressure. The water pressure to the sprays will be _____ psig.

Card No. 4
Job No. __

___ WATER CHILLERS: _____ dry semi-flooded flooded water chillers with a removable tube bundle equal and similar to those manufactured by _____ _____ shall be furnished of the shell and tube type with headers at one each end. The tube shall be copper _____, and the water shall flow through the tubes shell. The chiller shall be complete with thermal and hand expansion valves, controls, valves, and accessories to operate as specified under "CONTROLS".

The chillers shall cool ___ gpm of water each from ___ F to ___ F with a refrigerant suction temperature of ___ F using "Freon 12" _____ as the refrigerant. The water circuits shall have a pressure drop not in excess of _____ psig and a refrigerant circuit drop not in excess of ___ psig. The chillers shall have a refrigerant operating capacity not in excess of _____ lb. The chillers shall have ___ independent refrigerant circuits.

Card No. 5
Job No. __

_____

___ HEATING COIL

(1) Winter Design Conditions
- (a) Outdoor ___ db, ___ wb
- (b) Indoor ___ db, ___ wb

(2) Coil Specifications
- (a) Heating Load
  - 1 Room Load _____ Btuh
  - 2 Total Load _____ Btuh
- (b) Total Air _____ cfm
- (c) Outside Air
  - Min. _____ cfm
  - Max. _____ cfm
- (d) Air through coils ___ cfm
- (e) Air entering coil ___ db, ___ wb
- (f) Air leaving coil ___ db, ___ wb
- (g) Max air vel through coil ___ fpm
- (h) Max pressure drop of air through coil ___ in. water
- (i) Min. rows of coils ___
- ( ) Water through coils ___ gpm
- ( ) Entering water temp ___ F
- ( ) Water pressure drop through coil ___ psi
- ( ) Steam pressure at coil inlet ___ psig

Card No. 6
Job No. ___

___

COOLING COIL

___ (1) Summer Design Conditions

(a) Outdoor ___ db
___ wb

(b) Indoor ___ db
___ wb

(2) Coil Specifications

(a) Cooling Load

1 Room Load,

HL _____Btuh
HS _____Btuh
HT _____Btuh

2 Total Load

HL _____Btuh
HS _____Btuh
HT _____Btuh

(b) Total Air _____cfm

(c) Outside Air

Min _____cfm
Max _____cfm

(d) Air through coils ___ cfm
(e) Air entering coil ___ db
___ wb
(f) Air leaving coil ___ db
___ wb
(g) Max. air vel. through coil ___ fpm
(h) Max. pressure drop of air through coil ___ in. water
(i) Min. rows of coil ___
( ) Saturation ref. suction temp. (12 F superheat) ___ F
( ) Entering water temp. ___ F
( ) Water through coil ___ gpm
( ) Water pressure drop through coil ___psig

Card No. 8
Job No. ___

___ FILTERS: The filters shall be of the one two inch thick _____ _____ type similar and equal to those manufactured by _____. The air velocity through the filters shall not be in excess of _____ 300 fpm and the pressure drop through the filters shall be not more than ___ inches of water pressure when they are dirty.

Card No. 7
Job No. ___

___ HUMIDIFIERS: The humidifying devices shall be of the spray or evaporative type designed for automatic control and shall have sufficient capacity in quantity of spray or evaporative surfaces to deliver at least ____ gallons of water per hour to air at ___ F.

Card No. 9
Job No. ___

___ HEAT EXCHANGER: The heat exchanger unit shall have a capacity to efficiently meet a heat loss requirement of _____ Btuh at the registers when supplied with the air quantity hereinafter specified. This unit shall be made of steel of a thickness of not less than 0.125" _____ and shall be absolutely gastight between the combustion chamber and the air passages. The air passages shall be baffled so as to assure thorough contact of air with all the heating surfaces.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication. You are also invited to submit answers to questions from others, which are paid for at regular rates

PREVENTING CONDENSATION ON STORE WINDOWS

I was very interested in reading the answers in the April issue to "W.L.'s" question about preventing condensation on store windows. All of the answers, with one exception, utilized the principle of passing warm air over the window. This air, heated by a booster heater of some kind, will raise the inside glass temperature above the dew point, thereby preventing condensation and causing evaporation of any previous condensation. This method as explained in the various answers will solve the problem of condensation.

The answer submitted by "S.R. H." brings many questions and doubts to my mind in my interpretation of his solution.

As I understand it, he plans to circulate air from the store proper across the inside surface of the glass whenever the humidistat actuates the fan switch. This room air will increase the temperature of the glass in the same manner but not to the same degree that air which has passed through a booster heater would warm the inside glass surface, and the relative humidity of this air will be the same as that of the room, where heated air would have both a higher temperature and a lower relative humidity, both factors aiding in the prevention and removal of condensation.

In order to actuate the fan under condensing conditions at 0 F outside and 69 F inside, the humidistat would have to be set to close the fan circuit whenever the humidity was above 15 to 18 per cent. At other higher outside temperatures, where the relative humidity inside can go to much higher values before condensation begins, the fan would run needlessly, unless the humidistat were readjusted for each change in conditions or a switch were installed for supplementary manual operation. If a wind were blowing parallel to the outside glass surface, it would lower the inside surface temperatures and cause condensation at a relative humidity even lower than 15 per cent with 0 F outside. From the above discussion it appears to me that automatic control would not be feasible in such a system, unless a much more complicated control than a humidistat were used. Manual operation would be necessary to supplement such a control and it would probably be easier and cheaper to use manual control exclusively.

With the usual relative humidities present in winter air conditioning systems of 30 to 40 per cent, the inside glass temperature would have to be raised considerably to prevent condensation and a large amount of room air would have to be passed over the window to raise the inside surface temperature high enough to prevent condensation. Therefore, in my opinion, a system using air which has been passed through a booster heater would provide operation that would prove to be more economical, efficient, and satisfactory.—J. P. H.

RETURN AIR INTAKE LOCATION IN THEATER

YOU ARE INVITED to comment on the following question from a consulting engineer. Suitable discussions of this matter will be published, and paid for at regular rates (with additional payment for sketches). Address The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"An architect has presented a problem of heating and cooling a theater by forced air. The auditorium is 51 x 188 in plan. The ceiling height is 25 ft at the screen and 8 ft at the rear, the seating being sloped accordingly.

"The requirements are for the use of sidewall outlets, with return air intakes located at the screen only, leading direct back to the fan. There is no provision for exhausting the ventilation or fresh air.

"My conclusion is that such a system, to both heat and cool this building, would be faulty and unsatisfactory, and I have declined to prepare designs on such a basis.

"The architect insists that other advice is to the contrary and that the system will be satisfactory in every way.

"I will appreciate comments."—T. L.

SUMMER-WINTER WATER HEATING SURVEYED

A field survey summarizing opinions of customers, utility men, and gas equipment manufacturers concerning the summer-winter hookup for supplying year 'round hot water service by means of a gas fired heating boiler has been published by the American Gas Association testing laboratories. Issued as research report 1060-B, field study of domestic hot water service from gas fired boilers, the report describes the various types of systems commonly utilized and comments on their performance.

Utilization engineers interviewed during this investigation expressed the opinion that the gas fired summer-winter hookup could be used most profitably in installations requiring a heat input of 80,000 Btu per hr or more. They also felt that unusually large installations, of 250,000 Btu or more, should be analyzed carefully to determine whether enough hot water demand exists to warrant the cost of boiler standby losses encountered during summer months.

Headquarters address of the AGA is 420 Lexington Ave., New York 17, N. Y.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Physiological Adjustments of Human Beings to Sudden Change in Environment

By Nathaniel Glickman,* Tohru Inouye,** Stanley E. Telser, M.D.,***
Robert W. Keeton, M.D.,† Ford K. Hick, M.D.,†† Chicago, Ill.,
and Maurice K. Fahnestock,††† Urbana, Ill.

This paper is the result of research sponsored by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in cooperation with the University of Illinois, College of Medicine

SUMMARY—A study of (1) the rapidity and magnitude of the physiological adjustments made by the body on exposure to sudden changes in environmental temperature; (2) the effect of different relative humidities in altering the adjustments when passing from a hot to a comfortable environment, and (3) the effect of different relative humidities on various physiological measurements with the body in approximate equilibrium with the environment. Tests were conducted on 5 healthy male medical students, 19 to 23 years of age. Subjects remained in a comfortable environment for one hour before and after one or two hour exposure in a hot room.

THE PHYSIOLOGICAL effect of different environmental temperatures and humidities on the human body has been studied extensively. The pattern of heat loss from the body under equilibrium conditions has been analyzed quantitatively over a rather wide range of environmental conditions (1, 2, 3, 4).[1] On the other hand, little attention has been given to the adjustments of the human body to sudden changes in environmental temperature and humidity. The investigations of Houghten et al (5, 6) have dealt with both subjective and objective observations on normal subjects, clothed, entering an air conditioned space from the hot outside or after approximately 15 minutes in a hot room. The time required for the attainment of comfort or for the disappearance of perspiration was not measurably affected when the relative humidity was varied from 30 to 90 per cent with the effective temperature remaining constant. Newton, Houghten et al (7, 8, 9) have studied the subjective responses of a large group of workers after entering and leaving cooled and air conditioned offices as

*Physiologist, Aero-Medical and Atmospheric Environment Unit, Department of Medicine, University of Illinois.
**Research Assistant, Department of Medicine, University of Illinois.
***Instructor in Medicine, Department of Medicine, University of Illinois.
†Head, Department of Medicine, University of Illinois. Member of ASHVE.
††Associate Professor of Medicine, Department of Medicine, University of Illinois.
†††Assistant Director, Engineering Experiment Station, Department of Mechanical Engineering, University of Illinois. Member of ASHVE.
[1]Numerals in parentheses refer to References.
Presented at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Coronado, Calif., June 1947.

well as after one or more hours of occupancy. Sheard et al (10) have demonstrated the role played by the extremities of subjects passing from a comfortable environment to a cooler or warmer environment. Hardy and Goodell (11) have just reported the results on subjects who were exposed for three hours to a warm environment (87.8 F) and then were conducted into an environment of 60.8-64.4 F for a four hour period. Metabolic rate, rectal and mean skin temperatures were measured and peripheral blood flow was computed. Upon exposure to cold, a temporary rise in rectal temperature was observed associated with a rapid decrease of the peripheral blood flow index.

General experience of the public has indicated that no ill effects are grossly apparent among normal individuals making the adjustments required by sudden cooling or sudden exposure to heat. This does not imply that these adjustments are accomplished with equal ease and without hazard by individuals with cardiovascular impairment. This problem and the effect of previous adaptation to heat or cold on these adjustments will be studied in the near future.

The experiments to be described were designed to study:

1. The rapidity and magnitude of the physiological adjustments made by the body on exposure to a sudden change in environmental temperature.

2. The effect of different relative humidities in altering the adjustments when passing from a hot to a comfortable environment.

3. The effect of different relative humidities on various physiological measurements with the body in approximate equilibrium with the environment.

Subjects and Experimental Conditions. Five healthy male medical students, ranging in age from 19 to 23 years (Table 1), were subjects for these experiments which were conducted from mid July to the end of September, 1946. Each subject participated in six experiments. They remained in the comfortable room for one hour with the relative humidity either at 30, 60 or 80 per cent before and after the one or two hour hot room exposures.

Table 1—Description of the Experimental Subjects

Subject	Age Yrs	Height Ft & In.	Weight Lb	Area Sq Ft
B.F.	23	5- 5¾	152	19.0
J.B.	23	5-11¾	138	19.6
E.M.	22	6-2	150	20.8
W.P.	23	5-8	167	20.4
M.B.	19	5- 8½	130	18.4

Procedure. The subjects reported to the laboratory about one hour after the last meal, either at 8:00 a. m. or at 1:00 p. m., and always reported at the same time of day for each of the six experiments. They were instructed to drink three 8-ounce glasses of water before reporting, and were required to remain seated in the office for about 20 min before entering the comfortable room (designated comfortable room 1 or C.R. 1). Immediately on entering the comfortable room, the subject reported his *comfort* vote and began disrobing. He was weighed in the nude wearing only wooden sandals of known weight and then dressed in the thermocouple union suit. He resumed his seat on the balance and remained sitting quietly until one hour had elapsed from the time of entrance into the comfortable room (Fig. 1). The subject then walked into the hot room and sat quietly in an identical balance for either one or two hours. After this he walked back into the comfortable room (designated comfortable room 2 or C.R. 2) and sat quietly in the first balance for one hour.

Fig. 1—Subject wearing thermocouple union suit and seated in a Troemner balance in the comfortable room.

Experimental Rooms and Environmental Conditions. The comfortable room was 12 ft wide, 14 ft long and 8 ft high, completely air conditioned and well insulated. It was maintained at a constant dry bulb temperature of 76 F ± 0.5 deg with relative humidities of 30, 60 or 80 per cent (effective temperatures of 68.8, 71.5 or 73.4 deg, respectively). The temperature of the environment, as measured by a globe thermometer, ranged between 76.2 and 76.6 F. Air velocity was constant and minimal and, as recorded by a vane type anemometer, was less than 25 fpm.

The hot room immediately adjoining the comfortable room was 19 ft wide, 21½ ft long, and 10 ft high. It was maintained at a dry bulb temperature of 98.5 F ± 1.0 deg with a relative humidity of 66 per cent ± 4 per cent (90.2 ET). The temperature of the environment, as measured by the globe thermometer, ranged between 97.2 and 98.8 F.

Equipment and Observations. Rectal and skin temperatures were obtained by a multiple lead constantan - copper thermocouple system leading to a potentiometer for the measurement of electromotive force (12). The rectal thermocouple was inserted for a distance of 10 cm, as indicated by a rubber stop. Mean skin temperatures were computed by appropriately weighting values for 18 points on the skin (13). A complete series of rectal and mean skin temperatures were obtained at intervals of 10 to 15 min, except during the adjustment period when they were recorded about every three minutes.

Two Troemner balances (Fig. 1) were used (sensitivity ± 0.5 gm at 80 kg load), one in each room, to obtain changes in weight of the subjects. The balances were modified by a wooden seat placed over the metal seat to reduce heat loss by conduction and a metal pan, replacing the foot rest, to catch any perspiration which might drip from

the body. The weight of the subject was recorded at intervals of 3 to 4 min.

Pulse rate was obtained by palpation of the radial artery at the wrist. It was recorded at intervals of 10 to 15 min after the subject had been in either room for 20 min and at intervals of 3 to 4 min after the subject changed rooms. The blood pressure was obtained by auscultation using an aneroid sphygmomanometer and was recorded at the same intervals as the pulse rate.

The scale for the subjective sensation of comfort was similar to that used by Houghten et al (5) and was as follows:

1—Cold
2—Cool
3—Slightly cool
4—Comfortable
5—Slightly warm
6—Warm
7—Hot

The subjects were trained in the use of the comfort scale before starting the series of experiments. Intermediate votes such as 2½, 3½, or 4½ were accepted during the adjustment period.

Perspiration was judged to have started when tiny beads were first visible. Usually, these appeared earliest on the forehead, upper lip and hands.

Statistical Analysis of the Data. Student's (14, 15) method and tables designated for determining the significance of the mean of a small series of paired differences were used.

Results

Mean Skin Temperature

Comfortable Room 1. Freeman and Lengyel (16) have reviewed the conflicting results in the literature (10, 17, 18, 19, 20, 21) on the effect of wide ranges in relative humidity on skin temperature. Some have reported results of observations on just a few points on the skin while others have reported on mean skin temperature. This report of Freeman and Lengyel details the results for many points on the body and reveals that in practically all instances the skin temperature is statistically significantly higher at the higher humidity. Mean skin temperatures have been calculated from the data given in Table 2 of their article. It was found to be 1.46 and 1.11 F deg higher at 90 per cent than at 20 per cent relative humidity when the dry bulb temperature of the environment was 75.2 and 89.6 F, respectively. The technical difficulties involved in maintaining a constant dry bulb temperature while raising the relative humidity may account for the greater increase in mean skin temperature at the lower environmental temperature.

Test data revealed that the relative humidity of comfortable room 1 had a distinct effect on the final mean skin temperature (Table 2). The final mean skin temperature of the subjects averaged 0.74 F deg higher at 80 then at 30 per cent ($P = 0.006$) and averaged 0.68 F deg higher at 60 than at 30 per cent ($P = 0.005$). No difference was observed between the values for 80 and 60 per cent.

There was a slight increase in mean skin temperature averaging 0.43 F deg ($P < 0.0005$) from the time the subject put on his union suit and resumed his seat on the balance until the end of the period. The few minutes that the subject was in the nude permitted a decrease which was followed by the

Table 2—Comfortable Room 1

Final Mean Skin and Rectal Temperatures, Average Rate of Evaporative Weight Loss, Comfort Vote, Pulse Rate and Blood Pressure

RH and ET[1]	30% and 68.8 ET				60% and 71.5 ET				80% and 73.4 ET				Comparison Per Cent	Probability
	M[3]	σ[4]	R[5]	N[6]	M	σ	R	N	M	σ	R	N		
Mean Skin Temperature F (MT_s)	92.02	0.770	91.1 to 93.4	10	92.70	0.958	91.4 to 94.0	10	92.76	0.901	91.5 to 94.2	10	60 vs 30 80 vs 30 80 vs 60	0.005 0.006 Insign.
Rectal Temperature F (T_r)	97.88	0.379	97.2 to 98.3	10	98.22	0.498	97.4 to 99.0	10	98.45	0.450	97.8 to 99.2	10	60 vs 30 80 vs 30 80 vs 60	0.009 0.002 0.030
Evaporative Weight Loss[2] gm/min	0.92	0.296	0.62 to 1.59	10	1.06	0.404	0.52 to 1.80	10	0.96	0.337	0.57 to 1.74	10	60 vs 30 80 vs 30 80 vs 60	Insign. Insign. Insign.
Comfort Vote	4.2	0.33	4 to 5	10	4.4	0.45	4 to 5	10	4.3	0.46	4 to 5	10	60 vs 30 80 vs 30 80 vs 60	Insign. Insign. Insign.
Pulse Rate beats/min	72.0	10.77	60 to 92	10	79.1	11.01	60 to 93	10	79.0	10.44	60 to 96	10	60 vs 30 80 vs 30 80 vs 60	0.015 0.019 Insign.
Blood Pressure Systolic mm Hg	108.8	5.36	102 to 112	6	105.9	9.95	88 to 120	7	111.0		106 to 116	2	60 vs 30 80 vs 30 80 vs 60	Insign. Insign. Insign.
Diastolic mm Hg	71.7	6.10	60 to 80	6	72.3	6.11	64 to 82	7	78.0		72 to 84	2	60 vs 30	Insign.

[1]Relative Humidity and Effective Temperature
[2]Average rate during the last 40 minutes of an hour
[3]Mean values
[4]Standard deviation
[5]Range
[6]Number of observations

return to normal shortly after being clothed in the suit.

Hot Room. Reference to Table 3 and Figs. 2 and 3 shows that the major part of the redistribution of blood is accomplished in 2½ to 10 min after entering the hot room.

Comfortable Room 2. On entering comfortable room 2, following the one hour hot room exposure, the decrease in mean skin temperature (Table 4) at 10 min was significantly greater at 30 than at 80 per cent relative humidity ($P = 0.018$), and greater at 60 than at 80 per cent ($P = 0.017$). There was no significant difference between the 30 and 60 per cent values. This effect was still noticeable for the 20 min values.

Following the two hour hot room exposure the decrease in mean skin temperature in comfortable room 2 at 10 min, in all 3 comparisons, was significantly greater at the lower humidities. This effect was somewhat less consistent at 20 min.

It should be noted that the mean skin temperature decreased about the same amount at 10 and 20 min for comparable relative humidities in comfortable room 2, irrespective of the previous length of exposure of one or two hours in the hot room. The rate of this decrease slowed noticeably in 4½ to 16 min.

The final mean skin temperature averaged 1.91 F deg lower at 30 ($P = 0.016$) than at 80 per cent relative humidity and 1.49 F deg lower at 60 ($P = 0.004$) than at 80 per cent. Thus, when moisture was present in the union suit (comfortable room 2) the effect of relative humidity in depressing the mean skin temperature was more evident than when the suit was relatively dry (comfortable room 1).

It may be concluded that the relative humidity of the environment is important in determining the rate and the extent of the decrease in mean skin temperature when perspiration is present on the skin and in the union suit.

Figs. 4 and 5 illustrate the changes of several different points on the surface of the body in making these adjustments. The time required for the skin temperature of a specific area to attain a comparative plateau after entering the hot room was prolonged when the entrance temperature was low. After all points reached a plateau, the surface temperature of the body was relatively uniform. In comfortable room 2 a more rapid fall in skin temperature and lower final skin temperatures were observed in the environment having a relative humidity of 30 per cent.

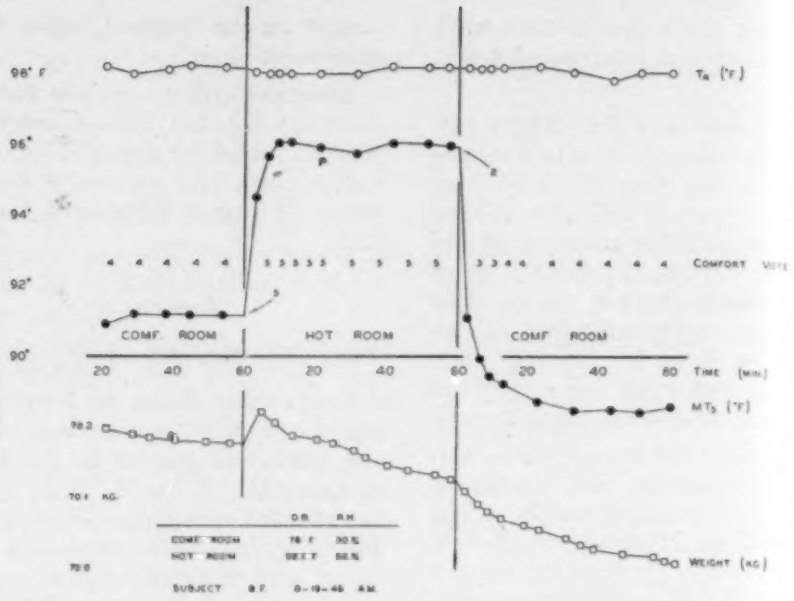


Fig. 2—Changes in rectal (T_r) and mean skin temperatures (MT_s), weight and sensations of warmth of a subject in a comfortable environment of 30 per cent RH followed by exposure to a hot moist environment for one hour and return to the comfortable environment. *P* indicates time of first visible perspiration

Table 3—Hot Room

Increase in Mean Skin and Rectal Temperatures (Deg F) From Final Values in Comfortable Room 1 and Time of Onset of Visible Perspiration

Observation	M[4]	σ[5]	R[6]	N[7]
Δ MT_s[1] at 10 Min	4.25	0.565	2.94 to 5.60	30
Δ MT_s at 20 Min	4.34	0.612	2.96 to 5.78	30
Δ MT_s at One Hour	4.35	0.726	2.75 to 5.84	30
Δ MT_s at Two Hours	4.67	0.780	3.51 to 5.94	15
Max Δ T_r[2] within 10 Min	—0.18[3]	0.155	0.2 to —0.6	30
Δ T_r at One Hour	0.41	0.484	1.2 to —0.5	30
Δ T_r at Two Hours	1.05	0.492	2.0 to 0.2	15
Time of Onset of Visible Perspiration (Minute)	11.0	7.24	2.5 to 29.0	28

[1]Change in Mean Skin Temperature
[2]Change in Rectal Temperature
[3]Probability < 0.0005
[4]Mean values
[5]Standard deviation
[6]Range
[7]Number of observations

Rectal Temperature

Comfortable Room 1. The effect of different relative humidities on rectal temperature at comfortable dry bulb temperatures has received little attention. Table 2 shows that the rectal temperature of the subjects averaged 0.57 F deg higher

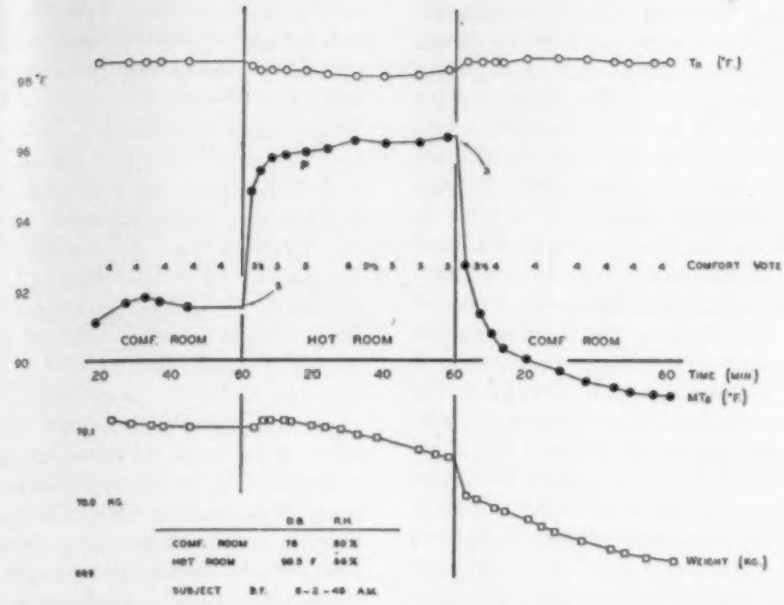


Fig. 3—Changes in rectal (T_r) and mean skin temperatures (MT_s), weight and sensations of warmth of a subject in a comfortable environment of 80 per cent RH followed by exposure to a hot moist environment for one hour and return to the comfortable environment. *P* indicates time of first visible perspiration

at 80 than at 30 per cent ($P = 0.002$), 0.23 F deg higher at 80 than at 60 per cent ($P = 0.030$), and 0.34 F higher at 60 than at 30 per cent ($P = 0.009$). There seems little doubt that the relative humidity had a distinct effect on the final rectal temperature.

In all but one experiment the rectal temperature fell during the one hour in comfortable room 1 ($P < 0.0005$). The average decrease was 0.38 F deg and the maximum was 1.0 F deg. The increase which occurred in the one case amounted to only 0.1 F deg. This decrease in rectal temperature has been noted by others (4) and may be ascribed to the reduction in heat production which occurs when the subject relaxes on the balance.

Hot Room. It has been noted how rapidly the redistribution of blood occurs as revealed by changes in mean skin temperature when a subject enters a hot room after having been in a comfortable environment and vice versa. In preliminary studies, discontinued in 1941, a statistically significant increase in rectal temperature was noted when subjects entered a comfortable environment after having been in a hot environment for one or two hours. The reverse was observed in a few experiments performed when the subjects entered the hot room after having been in a comfortable environment for one hour. This observation has been reported by others (22, 23, 24, 25, 26, 11).

Test results (Table 3) showed that within 10 min of entering the hot room a small but true decrease in rectal temperature occurred. The extent of this decrease was not affected by the relative humidity of comfortable room 1. The maximum decrease recorded was 0.6 F deg, and the average was 0.18 F deg ($P < 0.0005$). On entering the hot room there is a transfer of heat from the deep to the superfical tissues as a result of the rapid redistribution of blood.

It required an average of 19.1

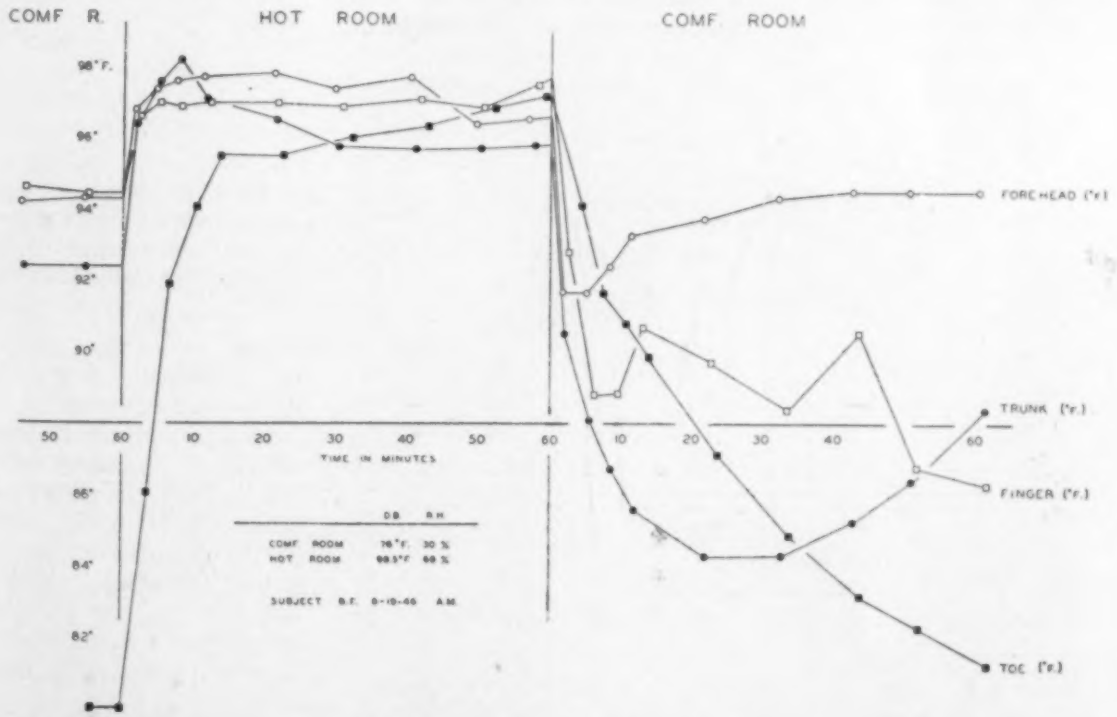


Fig. 4—Changes in skin temperatures of four sites on the body of a subject (trunk represents mean of 6 points) in a comfortable environment of 30 per cent RH followed by exposure to a hot moist environment for one hour and return to the comfortable environment

min for the rectal temperature to begin increasing and an average of 25.6 min to return to the level observed immediately prior to entrance. Thus, during the first 20-25 min, part of the heat, instead of being dissipated into the environment, was being utilized to warm the superficial tissues. During this period the body was completing the adjustments required to establish equilibrium with the environment, including increasing activity of the sweat glands.

After the initial decrease was completed the average rate of increase was 0.92 F deg per hour for the remainder of the hour and 0.55 F deg per hour for the second hour. This difference was significant ($P < 0.0005$) and indicated that the heat loss from the body was more rapid during the second hour.

After one hour in the hot room the rectal temperature averaged 0.41 F deg higher than the final comfortable room 1 value and after two hours in the hot room averaged 1.05 F deg higher.

Comfortable Room 2. A small but definite increase in rectal temperature was observed within 10 min of entering comfortable room 2, confirming the authors' unpublished results of 1941 (Table 4). As has been mentioned, similar results have been obtained by Shoji and Ogata (26) and Hardy and Goodell (11). This increase occurred whether the exposure had been for one or two hours in the hot room and averaged 0.19 F deg ($P < 0.001$) and 0.15 F deg ($P = 0.0006$) for the one and two hour hot room exposures, respectively. The maximum increase recorded was 0.5 F deg. Further, it should be noted that this increase occurred to the same extent whether the relative humidity in comfortable room 2 was high or low.

The rectal temperature decreased 0.29 F deg more ($P = 0.006$) after a two hour than after a one hour hot room exposure, although the final rectal temperature averaged 0.30 F deg higher ($P = 0.0015$) after the two hour exposure. Since, in most instances, the union suits contained more moisture after two hours in the hot room, the subjects had a greater heat loss after the longer exposure to heat.

Time of Observation of First Visible Perspiration in Hot Room. The earliest that perspiration was observed was 2½ min, the latest 20 min after entering the hot room. One subject perspired early in all six of his experiments (2½ to 4½ min) while on another subject perspiration appeared as early as 10 min and as late as 29 min. Thus, the time of appearance of visible perspiration varied from one subject to another and even in the same subject from one experiment to another.

The relative humidity in comfortable room 1 had a definite effect on the time of onset of visible perspiration in the hot room. When the subjects had previously been exposed to an 80 per cent relative humidity in comfortable room 1, the average time for the onset of visible perspiration was 6.8 min less ($P = 0.004$) than when the previous exposure had been 30 per cent. It is interesting to note that both the final rectal and mean skin temperatures were higher at 80 per cent than at 30 per cent relative humidity in comfortable room 1. In short, the subjects were nearer the zone of evaporative regulation when in the environment having a relative humidity of 80 per cent.

Comfort Vote

Comfortable Room 1. The subjects and observers noted on entrance that comfortable room 1 at 80 per cent relative humidity felt slightly less comfortable (on the warm side of the scale) than at the other humidities. This difference was too slight to alter the comfort vote when no perspiration was present on the skin. The final comfort vote in comfortable room 1 was unaffected by the relative humidity.

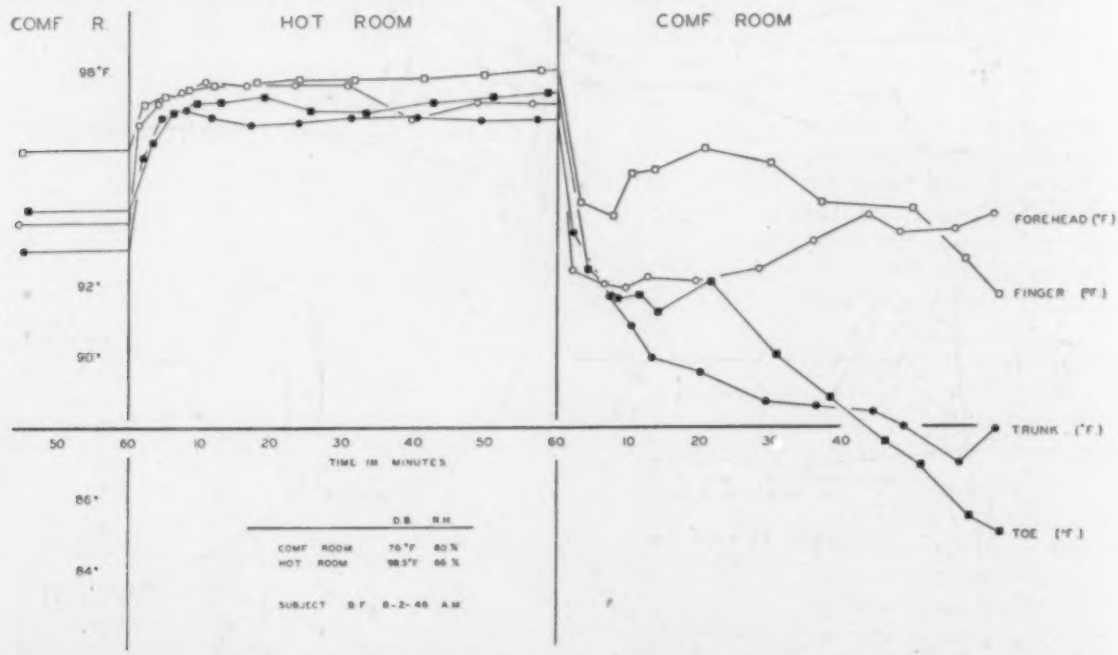


Fig. 5—Changes in skin temperatures of four sites on the body of a subject (trunk represents mean of 6 points) in a comfortable environment of 80 per cent RH followed by exposure to a hot moist environment for one hour and return to the comfortable environment

In 23 of the 30 experiments the subjects were comfortable at all humidities. Two of the five subjects felt slightly warm (voted 5) in 7 experiments (3 at 80, 3 at 60, and 1 at 30 per cent) and, of the two, one felt slightly warm in 5 of his 6 tests. Thus, all of the slightly warm votes, after one hour in comfortable room 1, were given by two subjects. These results, therefore, represent differences of individuals rather than differences due to the environment.

Hot Room. The sensation of warmth obtained on entering the hot room showed individual variations and bore no relationship to the relative humidity of comfortable room 1 from which the subjects had entered. Two of the five subjects voted 5 (slightly warm) in all but one of their experiments; one subject voted 7 (hot) in all but one experiment and one subject voted 7 in 2 experiments. So, on entrance into the hot room, there were 11 votes of 5, 12 votes of 6 and 7 votes of 7.

The final hot room votes also represent differences of individuals. The two subjects who consistently voted 5 on entrance gave final votes of 5 or 6 in all but 2 experiments. The other three subjects voted 7 in all but one experiment.

Comfortable Room 2. The votes on entrance into comfortable room 2 varied from 1 to 3, with one exception. One subject (W.P.) who always perspired freely in the hot room voted 0. In 24 experiments the comfort vote during the first minute remained the same as the entrance vote. However, two subjects in 6 experiments lowered their vote indicating that they felt still cooler.

There are a number of factors which would presumably affect the degree of coolness experienced by healthy persons on entering a comfortable environment of constant dry bulb temperature from a hot environment. These include the amount of moisture present on the skin and in the clothing, the feeling of warmth, the level of skin and rectal temperature and the relative humidity of the comfortable environment.

Houghten et al (5) reported *a reasonably good correlation* between the degree of perspiration experienced before entering a cooled space and the comfort vote on entrance (correlation coefficient of –0.47 as calculated by the authors from data shown in Fig. 10 of his paper). Test subjects were fewer in number and exposed to a slightly higher effective temperature for a longer period of time in the hot room. Nevertheless, no correlation could be demonstrated between the comfort vote and the amount of moisture present on the skin and in the union suit at the time of entrance into comfortable room 2 (see Table 7). It is difficult to visualize why such a relationship per se should exist, since the comfort vote is given immediately on entrance and this is too soon for evaporative heat loss to become the dominant factor.

Houghten et al (5) also reported, *a reasonably good correlation* between the degree of warmth before entering a cooled space and the comfort vote on entrance. The correlation coefficient for his data, as calculated by the authors is –0.53 and is –0.50 for their data. This suggests that the higher the vote in the hot room the lower will be

Table 4—Comfortable Room 2

Decrease in Mean Skin and Rectal Temperatures (Deg F) From Final Values in Hot Room After One Hour in Hot Room

Observation	M[1]	σ[2]	R[3]	N[4]	Comparison Per cent	Probability
ΔMT_s at 10 min in 30% RH	6.60	0.804	5.20 to 7.45	15	30 *vs* 80	0.018
ΔMT_s at 10 min in 60% RH	6.33	0.550	5.59 to 7.09	15	30 *vs* 60	Insign.
ΔMT_s at 10 min in 80% RH	5.29	0.452	4.56 to 5.96	15	60 *vs* 80	0.017
ΔMT_s at 20 min in 30% RH	7.30	1.139	5.21 to 8.50	15	30 *vs* 80	0.009
ΔMT_s at 20 min in 60% RH	7.36	0.495	6.66 to 7.95	15	30 *vs* 60	Insign.
ΔMT_s at 20 min in 80% RH	6.19	0.581	5.13 to 6.78	15	60 *vs* 80	0.027
Max ΔT_r within 10 min .....—0.19		0.115	0.4 to 0.0	15	Final Hot Room T_r *vs* Max T_r within 10 min in Comfortable Room 2	<0.001
After Two Hours in Hot Room						
ΔMT_s at 10 min in 30% RH	6.92	0.574	6.02 to 7.59	15	30 *vs* 80	0.001
ΔMT_s at 10 min in 60% RH	6.06	0.281	5.51 to 6.39	15	30 *vs* 60	0.001
ΔMT_s at 10 min in 80% RH	5.18	0.424	4.59 to 5.65	15	60 *vs* 80	0.018
ΔMT_s at 20 min in 30% RH	8.35	0.789	7.14 to 9.61	15	30 *vs* 80	<0.001
ΔMT_s at 20 min in 60% RH	7.25	0.359	6.70 to 7.70	15	30 *vs* 60	0.027
ΔMT_s at 20 min in 80% RH	6.25	0.544	5.39 to 6.79	15	60 *vs* 80	0.045
Max ΔT_r within 10 min .....—0.15		0.135	0.5 to —0.1	14	Final Hot Room T_r *vs* Max T_r within 10 min in Comfortable Room 2	0.001

[1]Mean value
[2]Standard deviation
[3]Range
[4]Number of observations

the vote on entrance to a comfortable environment.

From the authors' test data it was expected that no relationship would exist between the final mean skin temperature in the hot room and the sensation of coolness on entering comfortable room 2, since all values were within a narrow range of 1.5 F deg. It is reasonable to expect that with a greater range in mean skin temperature such a relationship might become apparent. There was also no relationship between the sensation of coolness on entering comfortable room 2 and either the final rectal temperature in the hot room or the relative humidity in comfortable room 2. There are undoubtedly many factors inherent in the individual as well as possible combinations of external factors which influence the vote and are difficult to interpret. At this time a more extensive analysis of the data has not been undertaken.

The data on the time required for the attainment of comfort in comfortable room 2, after the hot room exposures, were difficult to analyze because in many of the experiments a vote of 4 was never obtained. Therefore, the data were examined in a manner which would yield information as to the relative effect of the three conditions studied on the time the votes of 3, 3½, and 4 were obtained. If, for example, a subject voted 3 after 16 minutes in comfortable room 2 at 80 per cent and required 22 minutes at 30 per cent relative humidity, it was considered that the environment of 80 per cent relative humidity had a favorable effect. The data for the 1 and 2 hour hot room experiments were combined and this type of comparison was made for the relative effect of the three humidity levels.

Of the 28 comparisons for the 3 environmental conditions in which a vote of 3 was obtained, 21 favored the higher relative humidities and 7 favored the lower relative humidities, a deviation of 7 from the ideal outcome of a random pattern. The standard deviation of the distribution of 28 events that may occur with equal probability in either of two ways is $\sqrt{0.5 \times 0.5 \times 28} = 2.646$. The probability is 0.014 that such an outcome as was observed would have resulted from the operation of random factors only.

Of the 28 comparisons for the 3 environmental conditions in which a vote of 3½ was obtained, 23 favored the higher relative humidities and 5 favored the lower relative humidities, a deviation of 9 from the ideal outcome of a random pattern. For the same number of comparisons obtained for the vote of 4 (when a subject did not vote 4 his response at the next lower vote was used), 21 favored the higher and 7 favored the lower relative humidities, a deviation of 7 from the ideal outcome of a random pattern. The probability that such an outcome as was observed would have resulted from the operation of random factors is 0.004 and 0.014, respectively. Thus, the data yield strong evidence that relative humidity does play a role in the rapidity of attainment of comfort under the experimental conditions imposed.

Mean Skin Temperature at the Time of Comfort Vote of 4. The relation of the sensation of warmth to skin temperature has been studied by a number of observers. Miura (18), Phelps and Vold (20), Ward (27) and Houghten et al (6) have made measurements on a few selected sites on the skin while Winslow et al (28, 29), Hardy et al (30)), Yaglou et al (31), and this laboratory (32) have made observations on mean skin temperature. Ward (27) has noted the difficulty in comparing the results of different investigators because of differences in sites measured, as well as in methods employed. Nevertheless, there is a uniformity of opinion that warmth sensations are definitely related to skin temperatures. It is believed that mean skin temperature is a better index than any specific point since specific points, particularly the extremities, show far greater variations from day to day and from subject to subject under the same environmental conditions. For example, low temperatures of the hands and feet have been recorded while subjects were comfortable (Fig. 4).

Winslow et al (28) reported the comfort votes to be on the pleasant side when the mean skin temperature ranged from 88.0 to 92.9 F. Hardy et al (30) reported mean skin temperatures between 91.4 and 93.5 F in the zone of vasomotor regulation, and Yaglou et al (31) reported that *comfort was associated with mean skin temperatures between 91.5 and 93.5 F in both men and women regardless of air temperature which varied from 53.5 to 84 F, amount of clothing worn (0 to 14.5 lb) and season of the year.* This laboratory has reported (32) that the mean skin temperature ranged from 92.3 to 93.8 F when the subjects were nude and under basal conditions in an environment in which they felt comfortable.

In the present study we have found a range in mean skin temperature of 91.1 to 94.1 F to be associated with comfort votes of 4 in comfortable room 1. Votes of 4½ or 5 with values below 94 F have also been observed.

In comfortable room 2, after the hot room exposure, the mean skin temperature ranged from 87.6 to 92.4 F when the subjects were voting 4. This range was practically identical, 87.6 to 92.3 F, at the time the subjects were voting 3½. Further, each subject showed a somewhat greater range in mean skin temperature in comfortable room 2 for a vote of 4 than in comfortable room 1.

It should be noted that the mean skin temperature alone cannot be used as an index of the subjective sensation of warmth during the early adjustment period when the subject passes from a hot environment to a comfortable environment or vice versa. This is due to the sudden and rapid change in the rate of heat exchange that occurs during this period.

Pulse Rate

Comfortable Room 1. Table 2 shows that the final pulse rate averaged 72.0, 79.1 and 79.0 for the environmental conditions of 30, 60 and 80 per cent relative humidity, respectively. The difference between the rates for the comparison of 30 per cent with 80 per cent was

definite ($P = 0.019$) as was the difference for the comparison of 30 per cent with 60 per cent ($P = 0.015$). This is not to be interpreted as a direct effect of relative humidity on the pulse rate but rather as a result of the increase in body temperature. Keeton et al (33) have shown a high degree of correlation between pulse rate and rectal temperature under more or less equilibrium conditions. Reference to Table 2 reveals that for these same two comparisons referred to previously both the final rectal and mean skin temperatures were significantly higher at the higher humidities.

Table 2 also shows the range in pulse rate obtained for the different subjects. It should be noted that the lowest values, 60, were given by one subject and the highest values, 92 to 96, by another subject.

Hot Room. The literature contains many reports on the effect of varying environmental temperatures and humidities on pulse rate (34, 35, 36, 37, 38). Haldane (34) reported an increase of 20 beats of the heart per minute for every 1 F deg rise in rectal temperature for subjects exposed in a hot room or in a Turkish bath.

An increase in pulse rate was observed on entering the hot room (Table 5, Figs. 6, 7). This increase was not related to the final rate in comfortable room 1, since the increase was about the same for the subjects with low pulse rates as it was for the subjects with high pulse rates. The increase averaged 7.7

Table 5—Pulse Rate and Blood Pressure Adjustments

	Hot Room						Comfortable Room 2					
	Comparison	D[1]	σ	R	N[2]	P[7]	Comparison	D[1]	σ	R	N[2]	P[7]
Pulse Rate beats/min	First P.R.[3] vs Final C.R. 1[4] P.R.	7.7	6.12	24 to −4	30	<0.0005	First P.R. vs Final Hot Room P.R.	−11.6	7.37	3 to −27	30	<0.0005
	One Hour P.R. vs Final C.R. 1 P.R.	10.2	7.54	26 to −4	30	<0.0005	Second P.R. vs First P.R.	1.6	4.18	12 to −6	30	0.025
	One Hour P.R. vs First P.R.	2.5	6.96	16 to −10	30	0.033	First P.R. at 80% vs First P.R. at 30%	−6.5	8.12	6 to −21	10	0.021
	Two Hour P.R. vs First P.R.	8.9	5.96	20 to −10	14	<0.0005	First P.R. at 60% vs First P.R. at 30%	−4.1	5.67	7 to −15	10	0.030
	Two Hour P.R. vs One Hour P.R.	5.1	4.39	14 to −2	14	0.0007	First P.R. at 80% vs First P.R. at 60%	−3.1	10.39	17 to −19	10	Insign.
							Final P.R. vs P.R. in C.R. 1 (1 Hour Hot Room Exposure)	−4.6	4.41	4 to −11	15	0.001
							Final P.R. vs Final P.R. in C.R. 1 (Two Hour Hot Room Exposure)	−2.8	6.09	8 to −17	15	0.055
Systolic Pressure mm Hg	First S.P.[5] vs Final C.R. 1 S.P.	6.4	7.13	21 to −12	14	0.004						
	Second S.P. vs First S.P.	−9.9	14.27	20 to −36	14	0.013						
	Lowest S.P. vs Final C.R. 1 S.P.	−14.1	10.93	2 to −32	14	<0.0005						
	One Hour S.P. vs Final C.R. 1 S.P.	−0.2	6.67	12 to −11	12	Insign.						
Diastolic Pressure mm Hg	First D.P.[6] vs Final C.R. 1 D.P.	−3.1	4.71	6 to −14	14	0.019						
	Second D.P. vs Final C.R. 1 D.P.	−6.1	8.57	2 to −31	14	0.013						
	Lowest D.P. vs Final C.R. 1 D.P.	−11.9	8.01	0 to −31	14	<0.0005						
	One Hour D.P. vs Final C.R. 1 D.P.	−3.0	4.30	2 to −14	12	0.022						

[1]Mean of the differences obtained for the designated comparison. Plus indicates that the first listed observation had a higher value.
[2]Number of cases
[3]Pulse rate
[4]Comfortable room 1
[5]Systolic pressure
[6]Diastolic pressure
[7]Probability.

beats per minute ($P<0.0005$) with a range of 24 to –4. There was no significant difference between the first and second pulse rate values taken after entrance into the hot room. The average time for obtaining these values was 4.1 and 8.1 min, respectively.

At the end of one hour in the hot room the pulse rate averaged 10.2 beats per minute faster ($P < 0.0005$) than the final comfortable room 1 value with a range of 26 to –4. It should be noted that the one hour pulse rate averaged only 2.5 beats per minute faster than the first value obtained in the hot room ($P = 0.033$).

In order to be certain that this increase in pulse rate which occurred on entering the hot room was not due to the muscular effort involved in walking into the adjoining room and getting seated on the balance, the experiments were repeated but the two rooms were kept at identical environmental conditions (76 F dry bulb, 30 per cent RH). No demonstrable change in pulse occurred under these conditions when the subjects changed rooms and remained seated on the balance for 15 min. Thus, the initial increase in pulse rate was primarily due to the vascular changes involved in the redistribution of blood which occurred within the first few minutes in the hot room. Further, as will be discussed later, a decrease in pulse rate occurred within a few minutes of entering comfortable room 2.

The pulse rate showed a further increase of 5.1 beats per minute ($P < 0.001$) between the first and second hour values in the hot room. This increase may justifiably be attributed to the increase in body temperature which occurred during this period.

Comfortable Room 2. Haldane (34) and Adolph and Fulton (38) have reported an immediate decrease in pulse rate when subjects entered a cool room after having been exposed to hot conditions. The authors' data confirm these observations.

The average decrease in pulse rate on entering comfortable room 2 for all 30 tests was 11.6 beats per minute ($P<0.0005$) with a range of 27 to –3. The extent of this decrease was the same whether the subjects had been in the hot room for one or two hours. However, the relative humidity of comfortable room 2 definitely affected the extent of this decrease. The pulse rate decreased 6.5 beats per minute more at 30 than at 80 per cent relative humidity ($P = 0.021$), 4.1 beats per minute more at 30 than at 60 per cent ($P = 0.030$) and 3.1 beats per minute more at 60 than at 80 per cent RH, although this difference was not statistically significant.

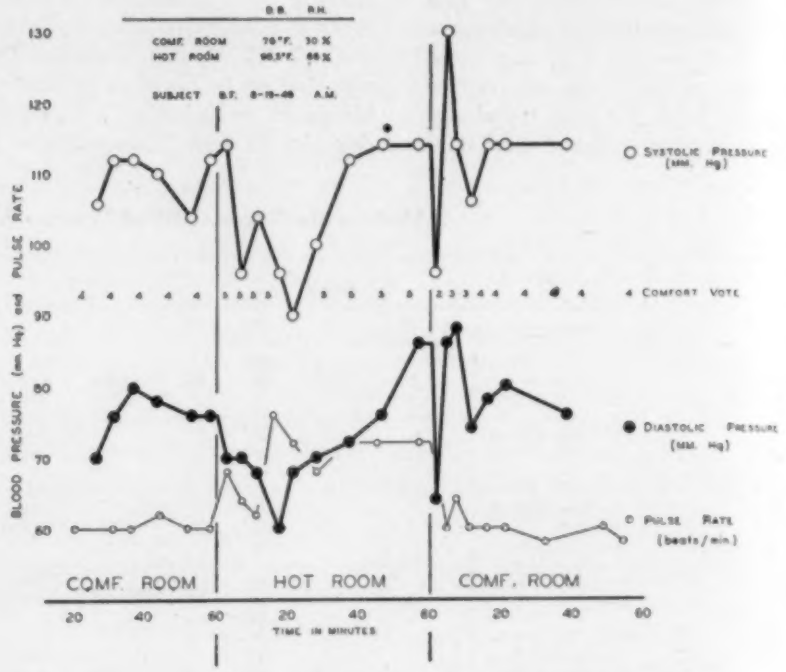


Fig. 6—Changes in blood pressure, pulse rate and sensation of warmth of a subject in a comfortable environment of 30 per cent RH followed by exposure to a hot moist environment for one hour and return to the comfortable environment. This graph illustrates the large fluctuations in blood pressure occasionally observed

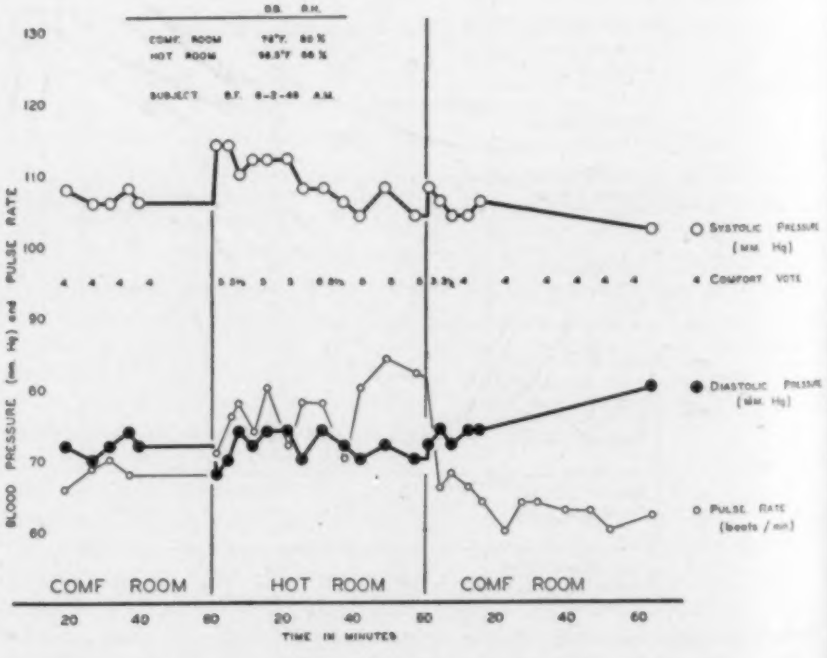


Fig. 7—Changes in blood pressure, pulse rate and sensation of warmth of a subject in a comfortable environment of 80 per cent RH followed by exposure to a hot moist environment

After an exposure of one hour in the hot room, the final pulse rate obtained in comfortable room 2 averaged 4.6 beats per minute less ($P = 0.001$) than the final pulse rate in comfortable room 1 (Figs. 6,7). A similar comparison after a two hour hot room exposure revealed no significant differences. The final rectal temperature in comfortable room 2, as has been mentioned, was higher following the two hour hot room exposure.

Blood Pressure

Comfortable Room 1. In most respects the changes in blood pressure, if any, were slight. The relative humidity had no effect on either the systolic or diastolic pressure.

Hot Room. Within two minutes of entering the hot room, there was a definite increase ($P = 0.004$) in systolic pressure of 6.4 mm Hg (range of 21 to –12) and a true decrease ($P = 0.019$) in diastolic pressure of 3.1 mm Hg (range 14 to –6). On the second reading, taken about 5.5 min after entrance, the systolic pressure declined 9.9 mm Hg ($P = 0.013$) from the initial reading while the diastolic pressure remained unchanged. Fig. 7 illustrates the occasional large fluctuations in blood pressure which may occur.

The decrease in diastolic pressure reflects a slight reduction in peripheral resistance brought about by the marked vasodilatation which occurs on entering the hot room. The transient initial increase in systolic pressure is unexplained. It may be due to psychic factors associated with anticipation of an unpleasant experience on entering a hot moist environment.

The greatest decrease in systolic and diastolic pressure occurred in about 12 to 15 min (Figs. 6, 7) and averaged 14.1 mm Hg (range of 32 to –2, $P < 0.001$) and 11.9 mm Hg (range of 31 to 0, $P < 0.001$), respectively. The time for this to occur was rather consistent for each subject. After one hour in the hot room, the systolic pressure had returned to the same level observed in comfortable room 1 while the diastolic pressure was only 3.1 mm Hg lower ($P = 0.022$). Information on the change in blood pressure between the first and second hours of a two hour hot room exposure is inconclusive because of too few observations. Further experiments are planned to elucidate this point.

Comfortable Room 2. No significant changes occurred in either systolic or diastolic pressure on entering, during, or after one hour.

Evaporative Weight Loss

Comfortable Room 1. It is agreed that the weight loss from total insensible perspiration is brought about primarily by the evaporation of water from the respiratory passages and skin and to a slight extent by the gaseous exchange of carbon dioxide and oxygen. Factors which may affect the insensible perspiration are the temperature, vapor pressure and air motion of the environment, the blood flow (39) and temperature of the skin (25, 39) and the metabolic rate (40). The data reported here were evaluated to determine whether the vapor pressure of the ambient air significantly altered total insensible perspiration.

The insensible weight loss was observed during approximately the last forty minutes of the one hour comfortable room 1 exposure period. Weight loss for the individual experiments (Figs. 2, 3) was quite constant during this period and the results are presented in Table 6.

Table 6—Average Rate of Evaporative Weight Loss in Comfortable Room 1 (gms/min)

Subject	Relative Humidity, Per Cent						Mean Rate	Mean Rate per M^2
	30	60	80	30	60	80		
B.F.	0.62	0.60	0.60	0.65	0.78	0.57	0.64	0.36
J.B.	0.88	0.97	1.17	0.70	1.17	1.06	0.99	0.55
E.M.	0.79	0.52	0.80	1.05	0.70	1.00	0.81	0.42
W.P.	1.19	1.80	1.74	1.59	1.57	1.18	1.51	0.80
M.B.	0.62	1.11	0.70	1.05	1.36	0.77	0.93	0.55

JOURNAL SECTION

For some subjects the variation from one experiment to another may be large. Subject M.B. (Table 6) had average rates ranging from 0.62 gm per min to 1.36 gm per min. On the other hand, subject B.F. had average rates ranging only from 0.57 to 0.78 gm per min. Adolph (41) reported mean rates of 0.42 and 0.64 gm per min for two subjects of approximately equal surface area in an environment of 76 F, 30 per cent RH.

The data revealed no significant difference in the mean rate of total insensible weight loss at the different humidities. This is in agreement with Wiley and Newburgh (17), who reported no differences in evaporative weight loss for a *clothed* subject exposed to relative humidities from 20 to 60 per cent, and with Winslow, Herrington and Gagge (21) for nude subjects in the zone of body cooling. Winslow explained this *identical evaporative heat loss* on the basis of an increased wetted area at the higher humidities. For clothed subjects in the zone of body cooling, Winslow, Herrington and Gagge (42) noted that the heat loss by evaporation was only 4 kgm cal per (sq m) (hr) less for high than for low humidities. On the other hand, Wiley and Newburgh (17) did find differences in evaporative weight loss at different humidities for a nude subject. Adachi and Ito (43) conducted experiments with one subject on the effect of breathing air at different humidities at 24—25 C. They reported that the loss through the skin varied inversely with the loss from the respiratory passages. Under extremely dry conditions the loss through the skin did not decrease sufficiently to compensate for the increased loss through the respiratory passages so that a slight increase in total loss occurred.

In the experiments described in this paper the thermocouple union suits of the subjects were placed in the comfortable room at least 24 hours before use and had attained approximate equilibrium with the environment. In a series of control experiments it was found that for every per cent increase in relative

humidity, between 30 and 80 per cent, the union suit increased approximately one gram in weight. At 80 per cent the union suit put on by the subject contained approximately 50 grams more moisture than when he put the same suit on at 30 per cent. Nelbach and Herrington (44) have reported even greater increases in weight in a man's woolen garment for comparable humidity changes. Further, in 4 experiments on one subject at 76 F dry bulb, 2 at 30 and 2 at 80 per cent RH, the subject was weighed in the nude, dressed in the union suit and his weight loss followed for one hour. No difference in total weight loss was observed but the union suit had lost more moisture at the higher than at the lower humidity.

It is the opinion of the authors that the lack of a significant difference in the average rate of total insensible weight loss under the experimental conditions imposed is due to a number of factors. The fact that the union suits initially contained more moisture at the higher humidities suggests that the measurements included, in addition to the total insensible perspiration, evaporation of moisture made available by the union suit. This also might cause a further compensatory decrease in cutaneous perspiration. The higher mean skin temperature observed at the higher relative humidities, on the other hand, would tend to increase very slightly the cutaneous perspiration. These factors operate to increase the total evaporative weight loss at higher humidities.

Hot Room. On entering the hot room the subject was weighed immediately after the blood pressure and pulse rate were recorded (average time, 3.3 min). The first observed weight averaged 24.3 gms more than the final weight obtained in comfortable room 1. This increase was due to the adsorption of moisture on the union suit from the ambient air.

Table 8 shows the evaporative heat loss in Cal per (sq m) (hr) for the first and second hours of the two hour hot room experiments. The values for the one hour hot room experiments have been omitted since they are in the same range as the first hour. In only one experiment did the evaporative heat loss during the first hour exceed that of the second hour, (W.P.) 60 per cent. The average evaporative heat loss was 13.87 Cal per (sq m) (hr) more ($P = 0.002$) during the second hour. This is accounted for by the delay in diffuse sweating.

Comfortable Room 2. Table 7 revealed that the subjects entered this room with variable amounts of moisture present on the skin and in the union suit. Under the experimental conditions imposed the total evaporative heat loss (Table 9) was apparently unaffected by the relative humidity. On the other hand, if moisture is taken into consideration, it can be demonstrated that the amount of heat loss by evaporation was definitely affected by the relative humidity. By expressing evaporative heat loss in relation to moisture present on the skin and in the union suit at entrance (Cal per (sq m) (hr) (gm) the loss was significantly greater ($P = 0.022$) at 30 than at 80 per cent relative humidity. No significant difference

Table 7—Approximation of Moisture (Grams) Present on Surface of Skin and in Union Suit at time of Entrance into Comfortable Room 2[1]

Subject	One Hour Hot Room Exposure			Two Hour Hot Room Exposure		
	RH of Comfortable Room, Per Cent					
	30	60	80	30	60	80
B.F.	133	264	184	350	400	218
J.B.	105	258	313	358	276	477
E.M.	176	262	187	397	214	311
W.P.	271	345	318	479	405	683
M.B.	224	284	140	232	355	374

[1]These values were computed as follows:
1. Obtain amount lost in 60 min in comfortable room 1.
2. Subtract (1) from total evaporative weight loss for 60 min in comfortable room 2.
3. Add residual moisture in union suit at termination of the experiment.
This assumes (possibly incorrectly) that the insensible weight loss is not altered by a wet covering on the skin. The error introduced by this assumption, regardless of other factors involved, will be small.

Table 8—Heat Loss by Evaporation (Cal/M²/hr) During the First and Second Hours of the Two Hour Hot Room Exposure

Subject	First Hour			Second Hour		
	RH in Comfortable Room, Per Cent					
	30	60	80	30	60	80
B.F.	19.5	21.4	29.8	43.1	35.7	30.8
J.B.	30.6	31.7	38.1	53.9	62.0	46.9
E.M.	7.7	25.9	24.8	35.8	35.8	36.4
W.P.	28.4	44.3	43.6	40.3	36.3	56.5
M.B.	37.2	42.3	28.7	50.5	56.6	51.6

Table 9—Heat Loss by Evaporation (Cal/M²/hr) in Comfortable Room 2

Subject	One Hour Hot Room Exposure			Two Hour Hot Room Exposure		
	RH of Comfortable Room, Per Cent					
	30	60	80	30	60	80
B.F.	33.6	49.1	43.5	66.5	58.2	43.5
J.B.	35.4	62.8	56.9	64.2	56.2	61.9
E.M.	53.5	63.6	52.5	76.6	51.4	56.2
W.P.	59.0	66.5	58.4	76.0	68.4	77.6
M.B.	56.4	68.5	41.9	43.3	70.0	52.7

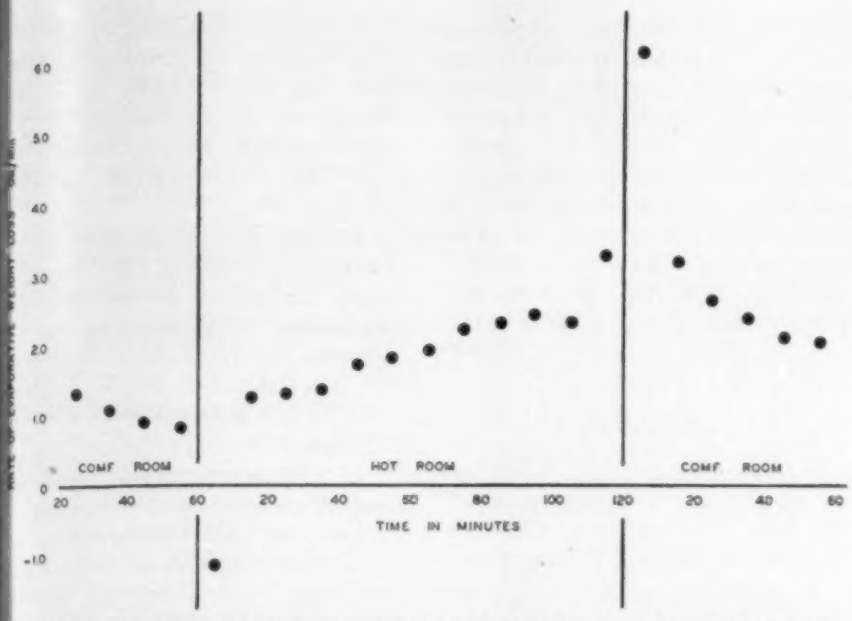


Fig. 8—Changes in mean rate of evaporative weight loss in gm/min for all subjects for all experiments in a comfortable environment, regardless of relative humidity, followed by exposure to a hot moist environment for one or two hours and return to the comfortable environment. Each point represents the mean of 30 experiments, except during the second hour in the hot room where each point represents the mean of 15 experiments

could be demonstrated for the comparison of 80 *vs* 60 or 60 *vs* 30 per cent relative humidity, although the trend was in the same direction as shown.

Fig. 8 shows the mean rate of evaporative weight loss on all subjects for all experiments. In comfortable room 1 the mean rate was most rapid immediately after the subject put on the union suit; in the hot room, after adsorption of moisture was completed (the first point indicates this gain in weight) the mean rate increased with time, and in comfortable room 2 the mean rate was most rapid during the first 10 minutes. Figs. 2 and 3 show the weight changes observed on one subject in two experiments.

Daily Outside Temperatures

Fig. 9 shows that during the period of this study Chicago enjoyed a relatively mild summer. The Annual Climatological Summary, 1946, for Chicago by the Weather Bureau of the United States Department of Commerce stated, *July was warm, dry and sunny, August was cool, dry and sunny, and September was dry and sunny, with average temperature somewhat above normal.*

Summary and Conclusions

Five healthy male medical students, clothed in 90 per cent cotton union suits and wooden sandals, were subjects for six experiments each. The subjects remained in a comfortable room for a control period of one hour. The dry bulb temperature was 76 F for all experiments. The relative humidity was maintained at either 30, 60 or 80 per cent. Thus, each subject was exposed to three separate environments. He then went into the hot room (98.5 F dry bulb, 66 per cent RH) for either one or two hours. This allowed a variable amount of perspiration to accumulate on the skin and in the union suit. He then returned to the comfortable room and remained for one hour. The subjects remained seated in a Troemner balance in both rooms. Observations on rectal and mean skin temperatures, evaporative weight loss, blood pressure, pulse rate and comfort vote were obtained.

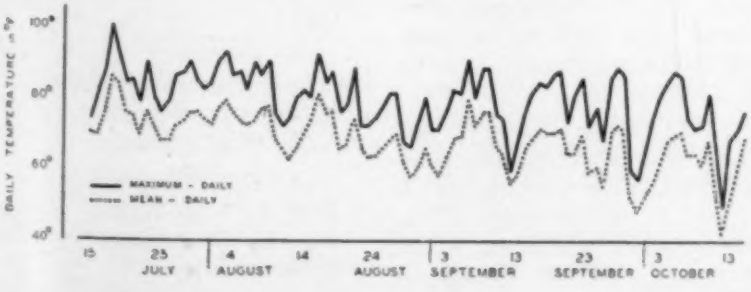


Fig. 9—Daily maximum and mean temperatures for Chicago as reported by the Weather Bureau

The data justify the following conclusions:

A. Adjustments to exposure of one hour in a comfortable environment at different humidities.

(*a*) the final mean skin and rectal temperatures and pulse rate were significantly higher at the higher humidities.

(*b*) the blood pressure was unaltered.

(*c*) the evaporative weight loss varied from one subject to another and from one experiment to another on the same subject so that, under the experimental conditions imposed (greater moisture content of the union suit at the higher humidities), no significant difference was observed at the different humidities.

(*d*) the differences in subjective sensation of warmth in the environments of different relative humidity were too slight to be significant and represent differences in individuals. In general, the votes were all 4 or 5.

B. Adjustments to entrance and exposures of one and two hours to a hot moist environment after being in equilibrium in a comfortable environment.

1. On entering the hot environment:

(*a*) the mean skin temperature rose quickly and attained approximately its maximum value in less than 10 min.

(*b*) the rectal temperature decreased within the first 10 minutes and then slowly increased.

(*c*) the pulse rate and systolic pressure increased, and the diastolic pressure decreased slightly.

(*d*) visible perspiration appeared as early as 2½ minutes and as late as 29 minutes, but it definitely appeared sooner when the subject had previously been exposed to the comfortable environment with an 80 per cent relative humidity as compared to one with 30 per cent. In the former environment the subjects were closer to the zone of evaporative regulation.

2. After one hour in the hot room:

(*a*) the mean skin temperature was about the same as after 10 minutes in the hot room.

(*b*) the rectal temperature averaged 0.41 F deg higher than the value in the comfortable room.

(*c*) the pulse rate was only 2½ beats per minute higher than the initial rate in the hot room.

(*d*) the systolic pressure returned to the level observed in the comfortable room while the diastolic pressure remained

slightly lower than the final comfortable room value.

3. After an additional hour in the hot room:
(*a*) the mean skin temperature was only 0.32 F deg higher.
(*b*) the rectal temperature increased 0.95 F deg.
(*c*) the pulse rate was 5.1 beats per minute faster.
(*d*) the heat loss by evaporation was greater during the second hour than during the first.
4. The comfort votes for two subjects were always 5 (slightly warm) on entrance and on only one occasion, during the second hour, did the vote reach 7 (hot). Three subjects voted *warm* or *hot* on entrance. These three all voted *hot* before the exposure terminated. Differences in individuals were again apparent.

C. Adjustments to entrance and exposure of one hour to a comfortable environment after exposure to a hot moist environment.

1. On entering the comfortable environment:
(*a*) the subjective sensation of comfort of most of the subjects was cool (2) or cold (1). In a few instances a vote of 3 was obtained which seemed to be related to the degree of warmth prior to entrance.
(*b*) the rate of decrease in mean skin temperature and the decrease in pulse rate was greater at the lower humidities.
(*c*) the rectal temperature increased within the first 10 min and then slowly decreased.
(*d*) the blood pressure remained unchanged.
2. The sensation of comfort, or near comfort, was attained earlier at the higher humidities. Some subjects never voted 4 (comfortable).
3. The subjects voted *comfortable* with lower mean skin temperatures than observed in the comfortable room before exposure to heat.
4. The difference in mean skin temperature between a low and a high relative humidity was greater after exposure to heat (comfortable room 2) than before exposure to heat (comfortable room 1).
5. Although the total evaporative weight loss was not affected by differences in relative humidity the heat loss, expressed in Cal per (sq m) (hr) (gm) moisture present in the union suit and on the skin at time of entrance, was significantly more at 30 than at 80 per cent relative humidity.

In general, the physiological adjustments made by healthy young adult males on passing from a comfortable to a hot moist environment, and vice versa, occurred rapidly and placed little strain on the cardiovascular system. The subjective sensation of warmth is slightly but insignificantly affected by a difference of 50 per cent in relative humidity (30-80 per cent) when relatively little moisture is present on the skin and in the union suit (comfortable room 1). However, after being exposed to a hot moist environment comfort 4 is attained sooner at the higher relative humidity when large amounts of moisture are present in the union suit (comfortable room 2). At 76 F dry bulb, large differences in relative humidity have a slight but significant effect on certain physiological observations.

References

1. The Mechanism of Heat Loss in Health and Disease, by E. F. Du Bois. (*Transactions of the Associated Physicians*, 51:252, 1936.)

2. Physiological Reactions of the Human Body to Varying Environmental Temperatures, by C.-E. A. Winslow, L. P. Herrington and A. P. Gagge. (*American Journal of Physiology*, 120:1, 1937.)

3. The Relative Influence of Radiation and Convection Upon Vasomotor Temperature Regulation, by L. P. Herrington, C.-E. A. Winslow and A. P. Gagge. (*American Journal of Physiology*, 120:133, 1937.)

4. Basal Metabolism, Radiation, Convection and Vaporization at Temperatures of 22 to 35 C, by J. D. Hardy and E. F. Du Bois. (*Journal of Nutrition*, 15:477, 1938.)

5. Cooling Requirements for Summer Comfort Air Conditioning, by F. C. Houghten, F. E. Giesecke, Cyril Tasker and Carl Gutberlet. (ASHVE TRANSACTIONS, Vol. 43, 1937, p. 145.)

6. Comfort Requirements for Low Humidity Air Conditioning, by F. C. Houghten, H. T. Olson and S. B. Gunst. (ASHVE TRANSACTIONS, Vol. 47, 1941, p. 139.)

7. Summer Cooling Requirements of 275 Workers in an Air Conditioned Office, by A. B. Newton, F. C. Houghten, Carl Gutberlet and R. W. Qualley. (ASHVE TRANSACTIONS, Vol. 44, 1938, p. 337.)

8. Shock Experiences of 275 Workers after Entering and Leaving Cooled and Air Conditioned Offices, by A. B. Newton, F. C. Houghten, Carl Gutberlet, R. W. Qualley and M. C. W. Tomlinson. (ASHVE TRANSACTIONS, Vol. 44, 1938, p. 571.)

9. General Reactions of 274 Office Workers to Summer Cooling and Air Conditioning, by F. C. Houghten, A. B. Newton, R. W. Qualley and E. Witkowski. (ASHVE TRANSACTIONS, Vol. 44, 1938, p. 591.)

10. The Role of the Extremities in the Dissipation of Heat from the Body in Various Atmospheric and Physiological Conditions, by Charles Sheard, M. M. D. Williams, G. M. Roth and B. T. Horton. (ASHVE TRANSACTIONS, Vol. 45, 1939, p. 135.)

11. Thermoregulatory Phenomena Associated with Exposure to Warm and Cold Environments, by J. D. Hardy and H. Goodell. (*Proceedings of the American Physiological Society*, 1947—In Press.)

12. The Tolerance of Man to Cold as Affected by Dietary Modifications: Protein Versus Carbohydrates, and the Effect of Variable Protective Clothing, by R. W. Keeton, E. H. Lambert, Nathaniel Glickman, H. H. Mitchell, J. H. Last and M. K. Fahnestock. (*American Journal of Physiology*, 146:66, 1946.)

13. The Technique of Measuring Radiation and Convection, by J. D. Hardy and E. F. Du Bois. (*Journal of Nutrition*, 15:461, 1938.)

14. The Probable Error of a Mean. *Student*. (Biometrika 6:1, 1908.)

15. New Tables for Testing the Significance of Observations. *Student*. (Metron 5:105, 1925.)

16. The Effects of High Humidity on Skin Temperature at Cool and Warm Conditions, by W. Freeman and B. A. Lengyel. (*Journal of Nutrition*, 17:43, 1939.)

17. The Relationship Between the Environment and the Basal Insensible Loss of Weight, by F. H. Wiley and L. H. Newburgh. (*Journal of Clinical Investigation*, 10:69, 1931.)

18. Humidity, Skin Temperature and Sense of Comfort, by U. Miura. (*American Journal of Hygiene*, 13:457, 1931.)

19. Skin Temperatures of Children, by F. B. Talbot. (*American Journal of Diseases of Children*, 42:965, 1931.)

20. Studies in Ventilation: Skin Temperature as Related to Atmo-

pheric Temperature and Humidity, by E. B. Phelps and A. Vold. (*American Journal of Public Health*, 24:959, 1934.)

21. Physiological Reactions of the Human Body to Various Atmospheric Humidities, by C.-E. A. Winslow, L. P. Herrington and A. P. Gagge. (*American Journal of Physiology*, 120:288, 1937.)

22. Experimentelle Untersuchungen über die tierische Wärme, by K. Yoshinaga. *Mitteilungen aus der Medizinischen Fakultat, Imperial University, Fukuoka.*, 10: 161, 1925.)

23. Zur Lehre von der Wärmeregulation, by W. Filehne. (*Archiv für Physiologie*, 1910, p. 551.)

24. Über den Schweiss und das Schwitzen, by A. Strasser. (*Zeitschrift für Physikalische und diatetische Therapie*, 18:129, 1914.)

25. The Physiology of Human Perspiration, by Y. Kuno. (Churchill, London, 1934, 268 pp.)

26. On the Change in the Rectal Temperature of Man When His Body Is Exposed to Extremely Cold Atmosphere, by R. Shoji and K. Ogata. (*Japanese Journal of Medical Science*, Biophysics, 6:85, 1939.)

27. The Measurement of Skin Temperature in Its Relation to the Sensation of Comfort, by E. F. Ward. (*American Journal of Hygiene*, 12:130, 1930.)

28. Relation Between Atmospheric Conditions, Physiological Reactions and Sensations of Pleasantness, by C.-E. A. Winslow, L. P. Herrington and A. P. Gagge. (*American Journal of Hygiene*, 26:103, 1937.)

29. The Influence of Clothing on the Physiological Reactions of the Human Body to Varying Environmental Temperatures, by A. P. Gagge, C.-E. A. Winslow and L. P. Herrington. (*American Journal of Physiology*, 124:30, 1938.)

30. Heat Loss from the Nude Body and the Peripheral Blood Flow at Temperatures of 22 C to 35 C, by J. D. Hardy and G. F. Soderstrom. (*Journal of Nutrition*, 16:493, 1938.)

31. The Importance of Clothing in Air Conditioning, by C. P. Yaglou and A. Messer. (*Journal of the American Medical Association*, 117:1261, 1941.)

32. Cardiac Output, Peripheral Blood Flow, and Blood Volume Changes in Normal Individuals Subjected to Varying Environmental Temperatures, by F. K. Hick, R. W. Keeton, Nathaniel Glickman and H. C. Wall. (ASHVE TRANSACTIONS, Vol. 45, 1939, p. 123.)

33. The Peripheral Type of Circulatory Failure in Experimental Heat Exhaustion. The Role of Posture, by R. W. Keeton, F. K. Hick, Nathaniel Glickman and M. M. Montgomery. (ASHVE TRANSACTIONS, Vol. 46, 1940, p. 157.)

34. The Influence of High Air Temperatures, by J. S. Haldane. (*Journal of Hygiene*, 5:494, 1905.)

35. Some Physiological Reactions to High Temperatures and Humidities, by W. J. McConnell and F. C. Houghten. (ASHVE TRANSACTIONS, Vol. 29, 1923, p. 129.)

36. Further Study of Physiological Reactions, by W. J. McConnell, F. C. Houghten and F. M. Phillips. (ASHVE TRANSACTIONS, Vol. 29, 1923, p. 353.)

37. The Index of Comfort at High Atmospheric Temperatures, by H. M. Vernon. (*Medical Research Council Special Reports*, No. 73:116, 1923.)

38. Effects of Exposure to High Temperatures Upon the Circulation in Man, by E. F. Adolph and W. B. Fulton. (*American Journal of Physiology*, 67:573, 1924.)

39. Evaporation from Human Skin with Sweat Glands Inactivated, by Ernest A. Pinson. (*American Journal of Physiology*, 137: 492, 1942.)

40. Insensible Perspiration: Its Relation to Human Physiology and Pathology, by F. G. Benedict and H. F. Root. (*Archives of Internal Medicine*, 38:1, 1926.)

41. The Initiation of Sweating in Response to Heat, by E. F. Adolph. (*American Journal of Physiology*, 145:710, 1946.)

42. The Reactions of the Clothed Human Body to Variations in Atmospheric Humidity, by C.-E. A. Winslow, L. P. Herrington and A. P. Gagge. (*American Journal of Physiology*, 124:692, 1938.)

43. Observations on the Insensible Loss from the Skin and the Respiratory Passages, by J. Adachi and S. Ito. (*Journal of Oriental Medicine*, 21:103, 1934.)

44. A note on the Hygroscopic Properties of Clothing in Relation to Human Heat Loss, by J. H. Nelbach and L. P. Herrington. (*Science*, 95:387, 1942.)

Climate and the Energy of Nations*

The second American edition of S. F. Markham's book, *Climate and the Energy of Nations*, has just been published by the Oxford University Press.

Well written, it deserves the attention of all those, whatever their calling, who are concerned with or interested in the factors that contribute to national greatness. Basically, of course, it analyzes the part that climate plays in the progress of civilization, with particular attention to modern developments whereby man effects a greater and greater control over his environment.

After considering climate as a factor in the history of civilization the author discusses human reactions to climate and suggests that, if due allowance is made for acclimatization and differences in weight of clothing, there is little difference between American and English ideals of indoor comfort. He defines the ideal zone as one in which indoor temperatures are maintained between 60 F and 76 F,

*By S. F. Markham. 2nd American Edition (1947), Oxford University Press. (230 pages, 4 appendices, $4.50.)

and relative humidities between 40 per cent and 70 per cent. In this zone of temperature and humidity, men work harder and more efficiently (at light muscular or sedentary work). His analysis of the ideal outdoor climate leads to the conclusion that the 70 deg isotherm has, throughout history, largely determined the pattern of civilization.

Analyses of such statistics as death rate, infant mortality, national income, and world trade, compiled by the League of Nations' Statistical Bureau, are given to support the contention that civilization and energy depend to no small degree on climate.

In a new chapter, Markham analyzes the problems which faced the United Nations Conference at Bretton Woods in setting up the International Money Fund and the International Bank. He suggests that in deciding the quota or share allocation the Conference had been guided in the main by the financial and trading strength of the various nations. Breaking down the quotas per country into amounts per head, he finds a general agreement with the health, wealth and trade statistics per head of the population of the countries concerned. The agreement recognizes, he says, the general backwardness of all tropical countries, whether nations in their own right or colonies.

The final chapter *What of the Future* discusses the power and influence of the principal nations and suggests that in sheer civilization, though not in punching power, New Zealand, Australia, the Netherlands, Switzerland and Canada head the list. In the United States, progress, Markham thinks, will be erratic and sporadic, since the dry champagne-like atmosphere of most of the middle west and the northeast lends itself easily to tension and consequent industrial disputes. He suggests that if the trend of population is to the Pacific states, the United States will add to its energy, but if it is to the central states or to the warm moist areas, a static tendency may be expected. He agrees, however, that the United States is solving this problem in another way, namely, by a great expansion in environmental control by the use of air conditioning.

Germany survives, he says, and sixty million industrious Germans will never be kept down, since this area is one of the best in the world for human energy. France, on the other hand, is a country of old people and few children, and is a declining force. Russia, by acquisition of areas on her western borders, has added immensely to her strength, for all the areas added were more energetic, healthy and prosperous than most areas of Russia proper. Russia's policy in citing certain industries in less climatically favorable areas in the east may influence a sizable portion of her population.

In the development of climatic control there is a steady tendency to increase the indoor winter temperature and instead of an *energy* ideal we may reach a *comfort* ideal. Coolness, he suggests, is a prime essential to physical work without which all mental effort becomes barren in result. There is little doubt, this reviewer feels, that the winter *comfort line* seems to have been creeping higher and higher, and even in radiant heating installations temperatures of 72 to 74 are being maintained. There is a need for more study of the significance of this fact.

Markham concludes by pointing out that it is the spiritual ideals which often direct human energy and shape civilization and that of all nations at all times none have found a formula so satisfying for spiritual unity as the United States. It represents one of the most successful spiritual amalgamations in history. With the knowledge before us there is a great opportunity to lead the world in health, energy, trade and culture.

Well supported by statistical data, even though they may be interpreted by some in other ways than those chosen by the author, this second edition is altogether a stimulating, interesting and valuable book.—CYRIL TASKER, director of research, ASHVE Research Laboratory, Cleveland, Ohio.

B. A. JOHNSON, CONSULTING ENGINEER

B. A. Johnson, until recently assistant to the engineering vice president, Minneapolis-Honeywell Regulator Co., has moved to Chicago, to become active in administrative and consulting work.

A graduate of the Milwaukee School of Engineering, Mr. Johnson has been engaged in engineering work since 1924 when he joined the staff of the Public Service Co. of Northern Illinois as a utilization engineer. After 12 years he left this company to join the Peoples Gas Light and Coke Co. as a staff engineer, later advancing to sales engineering manager in the domestic sales department. In this position he became widely known for his work on gas heating equipment problems. During the war year of 1942, he joined the Minneapolis-Honeywell Regulator Co., working in their Chicago war plant. In 1945, at the close of the war, he was transferred to the Minneapolis office where he became assistant to the engineering vice president.

B. A. Johnson

His immediate association will be with Barney Olson Inc., and the Condensation Engineering Corp., 122 South Michigan Ave., Chicago, Ill., where his office will be located.

NEW NAME FOR THE AVIATION CORP.

According to a recent announcement made by Spencer Heater Div., The Aviation Corp., the name of the corporation has been changed to the Avco Manufacturing Corp.

This was decided upon at the annual meeting of the stockholders March 25, 1947. The new name is believed to reflect more clearly the character of the diversified manufacturing operations of all divisions.

Determination of Outside Design Temperatures

A SUGGESTED APPROACH

By W. L. Holladay*, Los Angeles, Calif.

SUMMARY—The author suggests a method of using present available Weather Bureau temperature records for establishing outside design temperatures for summer and winter.

Nomographs are included for determining (1) winter design temperatures from the average minimum and lowest temperatures, and (2) summer design temperatures from average maximum temperature and highest temperature.

DESIGN temperature might be defined roughly as the answer to the question, *How cold (or hot) is it likely to be?* The problem of answering this question numerically arose in connection with the preparation of an application manual for a heat pump air conditioning unit. There are a number of published tables of winter and summer design temperatures, but the most complete one, in THE GUIDE 1947,[1] lists only 161 cities, including six in California. Since the geographical variation in weather conditions in the West is large, these tables, good as they are, do not give the information for localities outside the metropolitan areas. As an example, the expected daily maximum temperatures in August at some points in Southern California, together with their air line distances from the coast, are shown in Table 1.

Table 1—Geographical Summer Temperature Variations

LOCATION	AVERAGE MAXIMUM TEMPERATURE AUGUST, F	DISTANCE FROM COAST IN MILES
Santa Monica	69	0
Los Angeles	82	13
Pasadena	89	22
Pomona	92	30
San Bernardino ...	96	48
Indio	106	75
Death Valley	114	200

The winter variations are striking also, ranging from near zero in the mountains to the upper 40's near the coast. The warmest winter location in Southern California seems to be Avalon, with an average January minimum temperature of 49 F.

When, for instance, two cities 10 or 20 miles apart have markedly different weather conditions, and neither locality is included in any of the lists of recommended design temperatures, it is necessary to devise a plan for determining the proper design temperatures.

The ASHVE Research Technical Advisory Committee on Weather Design Conditions has recommended the adoption for heating of an outside design temperature which is equalled or exceeded during 97½ per cent of the hours in December, January, February and March. The validity of the recommendation is recognized but the work has not been completed due to the staggering task of analyzing 2904 hourly temperatures for the number of hours a Weather Bureau has been in operation for each city where heating appliances may be installed. It is probable that the design values will be compiled only for the larger cities.

Necessary to Estimate Outside Conditions

For a long time it was assumed that a cooling load should be figured on a 15 deg temperature difference between outside and inside, but the present trend (HEATING, VENTILATING, AIR CONDITIONING GUIDE 1947, Chap. 15, Table 1) is to adopt fixed inside conditions, which would make it necessary to estimate outside conditions. Incidentally, the temperature difference is normally used only as a base or starting point in most systems of load calculations; it is corrected for solar load, thermal inertia of the building, etc.

Weather Bureau data[2] are published for the years up to 1930 for nearly every town of any consequence, the readings being taken under standardized conditions and therefore being consistent with each other. The author has sought a way to put this information to good use. In general, the following temperatures by months are available: average temperature; average maximum temperature; average minimum temperature; highest temperature; lowest temperature.

For most stations, average temperature is defined as the mean of the highest and lowest daily reading. This is useful as a base for degree-day or fuel consumption calculations, but is obviously not useful for design purposes.

Average maximum temperature is the average of the highest daily temperatures for a calendar month. This temperature for August was used in Table 1.

*Manager, Field Engineering, Drayer-Hanson, Inc. Associate Member of ASHVE.

[1]Exponent numerals refer to Bibliography.

Presented at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Coronado, June 1947.

JOURNAL SECTION

Average minimum temperature is the average of the lowest daily temperatures for a calendar month.

Highest and lowest temperatures are also available by months, the values published being extremes rather than averages. As an example, see figures for San Diego shown in Table 2.

It will be apparent that the winter design temperature should be somewhere between the *average minimum* in the coldest month and the *lowest*—in this case between 47 and 25 F. The 25 F value occurred once in January 1913 (the record extends back to 1872) and may be repeated or even reduced some day. Severns[3] is one of several authors suggesting a design figure 10 to 15 F deg above the lowest temperature on record. The *average annual minimum*, obtained by averaging the lowest temperatures (one for each year) recorded for the period of years the local Weather Bureau has been in operation, seems like a reasonable figure to use, and for several years THE GUIDE implied that this figure might be useful, but it has been deleted from the 1947 edition. The median difference between the average annual minimum and the lowest recorded, incidentally, is 17 deg. The author believes that any system based at least partially on an average is likely to give more consistent results than one based on one unique reading such as the lowest recorded temperature. The average annual minimum is available from each *local* Weather Bureau, but is published nationally only for one or two selected cities in each geographical section.

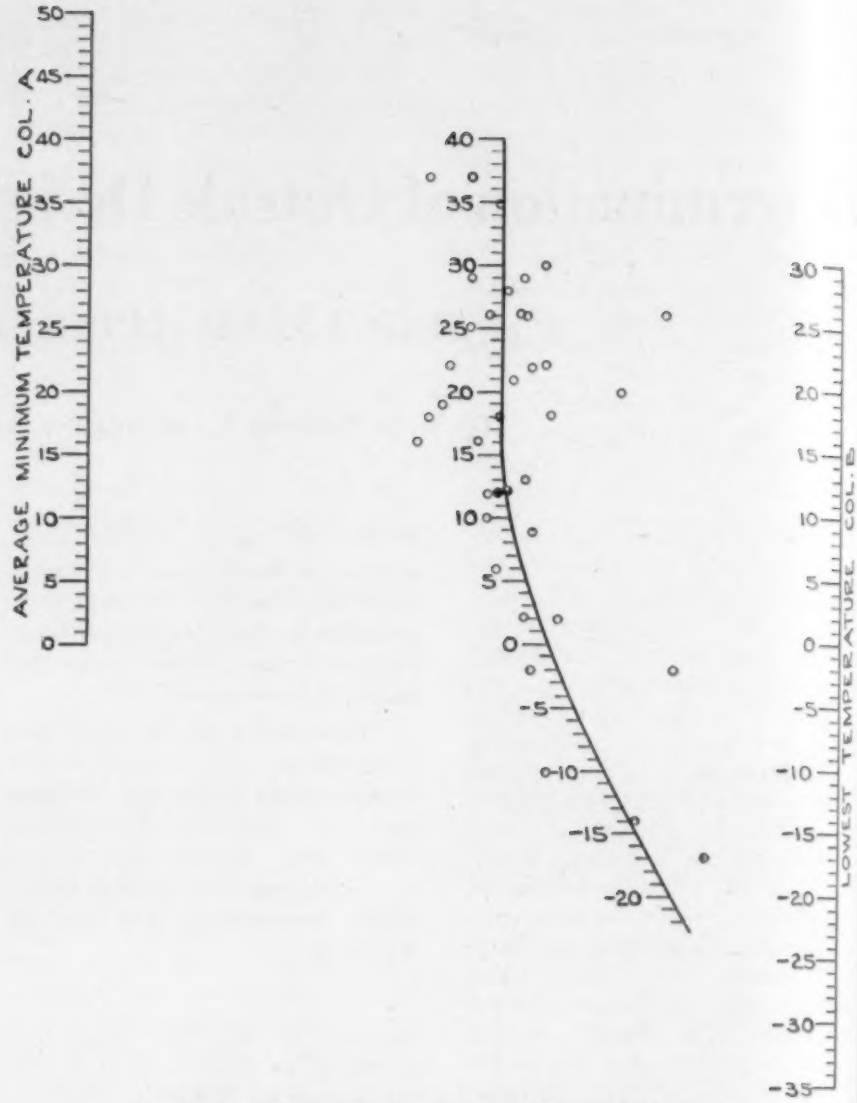


Fig. 1—Nomograph for winter design temperatures

Why Not Use Average Annual Minimum?

Why not use a value corresponding to the *average annual minimum?* Does it not seem reasonable that if a heating plant will hold a satisfactory temperature under the coldest condition prevailing in a normal year, that building heat lag, solar heat, and internal heat of various kinds will carry it past the rare condition which is worse than the average?

If the *average annual minimum* is accepted as a starting point, the problem becomes that of choosing design temperatures for those towns where this figure is not published, and it seemed to the author that the average minimum and the lowest could be combined in some way to produce a temperature equivalent to the *average annual minimum.* This investigation covers the southern and western states only, and results are shown in Table 3.

A nomograph was prepared to show the relationship among the three variables listed in Columns A, B and C of Table 3, and the points obtained are shown in Fig. 1. If a smooth curve is drawn through

Table 2—San Diego Temperatures[a] (F deg)

	Average	Average Maximum	Average Minimum	Highest	Lowest
Jan.	55	62	47	85	25
Feb.	55	63	48	89	34
Mar.	57	64	50	99	36
Apr.	59	65	52	96	39
May	61	66	56	98	45
June	64	69	59	94	50
July	67	72	62	100	54
Aug.	69	74	64	93	54
Sept.	67	73	61	110	50
Oct.	64	70	57	96	44
Nov.	60	68	52	93	36
Dec.	56	64	48	84	32
Year	61	68	55	110	25

[a]To the nearest degree. Weather Bureau averages are to tenths.

Table 3—Comparisons of Temperatures, Southern and Western Cities (F deg)

		A Average Minimum	B Lowest	C Average Annual Minimum	D Indicated Design	E ACRMA Heating Design
Alabama	Birmingham	37	—10	12	11	10
	Mobile	43	— 1	22	19	
Arizona	Clemenceau	32	15	20	23	
	Flagstaff	14	—25	—14	—14	
	Phoenix	38	12	25	24	
	Yuma	42	22	30	31	
Arkansas	Fort Smith	30	—15	6	4	
	Little Rock	34	—12	10	9	5
California	Eureka	41	20	29	30	
	Fresno	38	17	26	26	
	Los Angeles	46	28	37	36	35
	Red Bluff	38	17	26	27	
	Sacramento	39	19	28	28	
	San Diego	47	25	35	35	
	San Francisco	45	27	37	35	35
	San Jose	38	22	26	29	
Florida	Jacksonville	48	10	29	28	25
Georgia	Atlanta	35	— 8	12	12	10
	Savannah	43	8	22	24	
Louisiana	New Orleans	47	7	26	25	20
	Shreveport	39	— 5	16	15	10
Mississippi	Vicksburg	40	— 1	18	18	
Nevada	Reno	21	—19	— 2	— 5	— 5
	Tonopah	24	—10	— 2	5	
	Winnemucca	17	—28	—10	—16	
North Carolina	Raleigh	33	— 2	13	14	
	Wilmington	38	5	18	20	
Oklahoma	Oklahoma City	27	—17	2	1	0
Oregon	Baker	17	—25	—17	—13	
	Portland	34	— 2	18	14	10
South Carolina	Charleston	43	7	22	23	15
	Columbia	37	— 2	19	16	
Tennessee	Knoxville	31	—16	2	3	
	Memphis	34	— 9	9	10	0
Texas	El Paso	32	— 5	16	12	10
	Fort Worth	36	— 8	12	12	10
	San Antonio	42	4	21	21	20

the center of these points, a means will be obtained for determining a recommended *design temperature* from *average minimum* and *lowest* temperatures only.

In order to determine the value of the method, Column D, Indicated Design, was taken from the curve by the usual nomograph scheme of laying a straightedge from average minimum to lowest temperature and reading the intersection with the curve. Neglecting sign, the average variation between Column C and Column D is 1.7 deg. Of the 37 localities listed, 32 have variations of three degrees or less. The correction would appear to be satisfactory in view of the general practice of using design temperatures expressed in multiples of five.

Some heating design figures from *Code of Application Engineering Standards for Air Conditioning for Comfort*[4] are included as Column E for comparison.

From temperatures listed in the Climatic Summary of the United States tables of recommended design temperatures have been prepared by the author for all towns having a population of 5000 or more and located in the states listed in

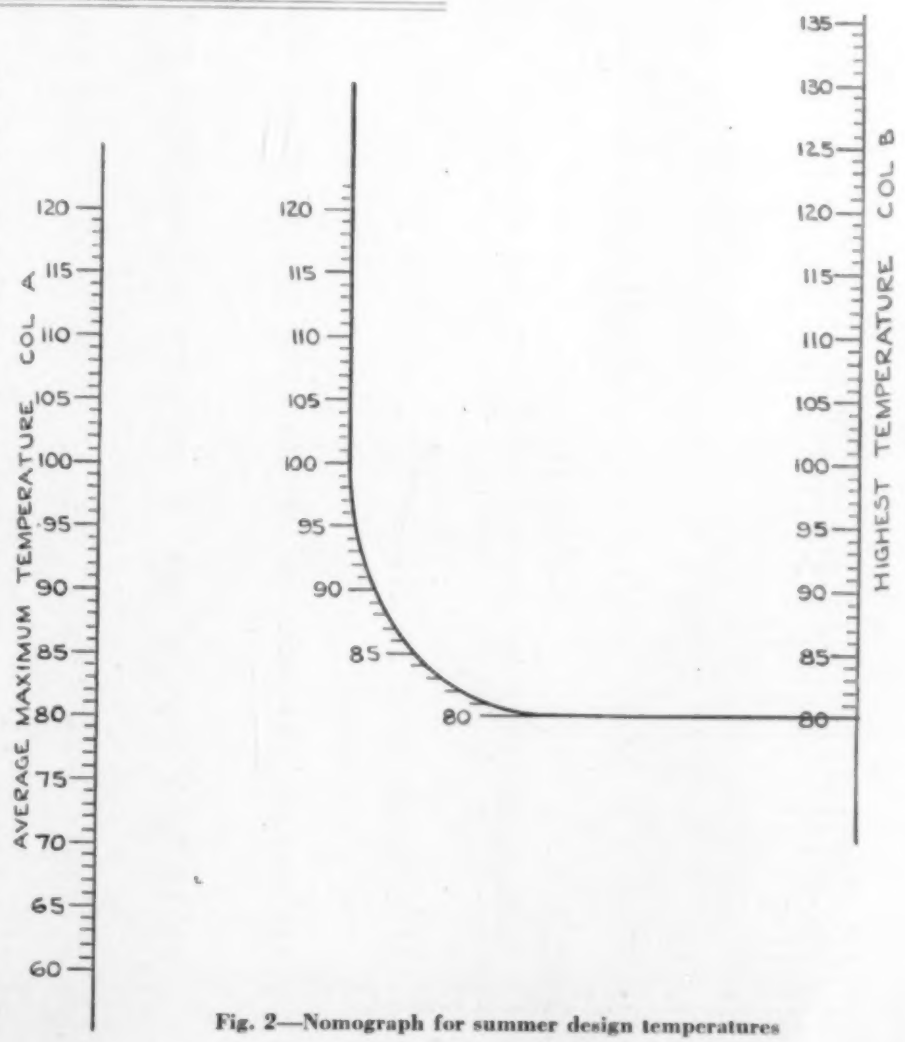


Fig. 2—Nomograph for summer design temperatures

JOURNAL SECTION

Table 3. The design temperatures selected to nearest 5 deg and the temperature records upon which they were based are listed in Table 5 for a sufficient number of cities to enable the reader to compare local design temperatures with those obtained by the author's recommended method.

In a similar way, summer design temperatures were developed from *average maximum* and *highest* temperatures. Because a number of tables of summer design conditions were available, efforts were made to meet an average of published figures, rather than to use the average annual maximum, which would correspond to the average annual minimum of the winter problem. The average annual maximum seems to be from five to ten degrees above the accepted summer design figure;

the reason it seems too high is that temperatures in most localities show greater day-night variations in the summer than in the winter and the thermal inertia of the building will help carry it past the daytime peak.

The nomograph shown in Fig. 2 developed for summer use changes from vertical to horizontal at 80 F, for the reason that most comfort air conditioning jobs, at least in the West, are laid out on the basis of an inside dry bulb of 80 F. Since it is not customary in load calculations to take advantage of negative heat flow, the minimum outside dry bulb was established at 80 F regardless of how low the Weather Bureau figures were. The transition from vertical to horizontal was laid out quite carefully so that ac-

Table 4—Summer Dry Bulb Design Temperatures (F deg)

	A Average Maximum	B Highest	C Indicated Design	D HVAC Guide 1947[1]	E ACRMA 1940[4]	F Heating[5] and Ventilating	G Marley[6]	H Albright[7,8]	I FB[8]
Alabama									
Birmingham	90	107	96	95	95				100
Mobile	90	103	94	92		94	93	95	
Montgomery	91	107	96	95					
Arizona									
Flagstaff	80	99	87	100[a]					
Phoenix	103	119	108	108	113		108	113	110
Tucson	98	112	103		105				105
Yuma	106	120	111	105[b]					
Arkansas									
Fort Smith	92	108	97	100					
Little Rock	90	108	96	96	95	95		103	100
California									
Fresno	99	115	104	104			104	110	105
Long Beach	80	103	89		90				
Los Angeles	82	109	92	90	90	88			99
Needles	108	125	114	102[b]					
Oakland	72	100	84		85		82	94	
Red Bluff	97	115	103	100					
Sacramento	89	114	97	105					
San Diego	74	110	88				82	88	95
San Francisco	68	101	83	90	85	85			85
Florida									
Jacksonville	90	104	95	95	95	94	96	99	95
Key West	89	100	93	95					
Miami	87	96	90	91	91		92	92	90
Tampa	90	98	93	94	94				93
Georgia									
Atlanta	87	103	93	95	95	91	96	101	100
Augusta	91	106	96	95					
Macon	90	105	95	95					
Savannah	90	105	95	95					
Thomasville	90	106	95	95					
Louisiana									
New Orleans	89	102	93	92	95	94	93	95	100
Shreveport	92	110	98	97	100		98	102	
Mississippi									
Jackson	83	107	98				98	103	
Meridian	90	105	95	95					
Vicksburg	90	104	95	95					98
Nevada									
Reno	88	102	93	95	95		95	102	97
Tonopah	86	98	90	95					
Winnemucca	89	104	94	95					
North Carolina									
Asheville	82	96	87	90					
Charlotte	88	103	93	95					
Raleigh	88	103	93	94			95	98	98
Wilmington	87	103	93	90			92	94	96
Oklahoma									
Oklahoma City	92	108	97	100	101	96			100
Tulsa	95	111	100		101		103	106	100
Oregon									
Baker	81	102	89	95					
Medford	91	110	97	90[b]					100
Portland	78	104	88	89	90	83	86	99	95
South Carolina									
Charleston	88	104	93	92	95	94	94	98	95
Columbia	90	106	95	95					99
Tennessee									
Chattanooga	88	104	93	95	95	94			
Knoxville	87	104	93	93			94	100	
Memphis	89	106	95	98	95		99	103	100
Nashville	89	106	95	98	95				100
Texas									
Abilene	94	110	99	100					100
Amarillo	88	106	94	97			97	101	100
Brownsville	93	104	97	92[b]			93[d]	96	
Corpus Christi	88	102	93	100					
Dallas	94	105	98		100	99	101	105[c]	100
El Paso	94	106	98	100	100		97	101	100
Ft. Worth	94	112	100	95	100				100
Galveston	88	100	92						95
Houston	93	108	98	98	95	93[d]	96	100	98
San Antonio	95	107	99	98		100	97	102	100

[a] — Higher than the Highest Temperature ever obtained
[b] — Lower than the Average Maximum Temperature
[c] — Highest ever recorded
[d] — Same as Average Maximum Temperature
[e] — These are not recommended dry bulb design temperatures but are the *peak temperatures to be expected . . . in a normal year*

Table 5—Maximum, Minimum, and Design Temperature (F deg)

	Cooling				Heating		
	Av. Max.	Highest Recorded	Design		Av. Min.	Lowest Recorded	Design
			Dry Bulb	Wet Bulb			
Alabama							
Anniston	89	105	95	78	35	−10	10
Birmingham	90	107	95	78	37	−10	10
Gadsden	92	108	95	77	34	−13	10
Mobile	90	103	95	80	43	− 1	20
Montgomery	91	107	95	78	40	− 5	15
Tuscaloosa	92	108	95	78	34	− 7	10
Arizona							
Bisbee	90	106	95	71	35	8	20
Douglas	96	111	100	70	29	− 7	10
Phoenix	103	119	110	75	38	12	25
Tucson	98	112	105	72	34	12	20
Arkansas							
Fort Smith	92	108	95	76	30	−15	5
Little Rock	90	108	95	79	34	−12	10
California							
Bakersfield	100	118	105	70	35	13	25
Berkeley	70	106	85	65	42	28	35
Fresno	99	115	105	70	38	17	25
Long Beach	80	103	90	68	42	21	30
Los Angeles	82	109	90	70	46	28	35
Oakland	72	100	85	65	42	29	35
Pasadena	89	113	95	73	39	21	30
Riverside	94	118	100	72	38	21	30
Sacramento	89	114	95	71	39	19	30
San Bernardino	96	116	105	73	37	18	25
San Diego	74	110	90	71	47	25	35
San Francisco	68	101	85	65	45	27	35
San Jose	80	104	90	70	38	22	25
Santa Ana	84	112	95	71	38	22	30
Santa Barbara	77	115	90	67	43	23	30
Santa Monica	69	104	85	67	43	26	35
Stockton	89	110	95	71	36	20	25
Florida							
Jacksonville	90	104	95	80	48	10	30
Miami	87	96	90	79	62	27	40
Orlando	92	103	95	79	50	18	35
Pensacola	87	103	95	80	46	7	25
Tampa	90	98	95	80	52	19	35
Georgia							
Atlanta	87	103	95	77	35	− 8	10
Augusta	91	106	95	78	38	3	20
Columbus	92	106	95	78	37	− 3	15
Macon	90	105	95	78	37	− 4	15
Rome	91	107	95	77	32	− 7	10
Savannah	90	105	95	79	43	8	20
Louisiana							
Alexandria	94	109	100	80	40	3	20
Baton Rouge	92	110	100	80	43	2	20
Monroe	93	109	100	80	38	− 3	15
Shreveport	92	110	100	79	39	− 5	15
Mississippi							
Jackson	93	107	100	79	38	3	20
Meridian	90	105	95	79	38	− 6	15
Nevada							
Reno	88	102	95	62	21	−19	− 5
North Carolina							
Asheville	82	96	90	74	29	− 6	10
Charlotte	88	103	95	76	33	− 5	10
Durham	89	104	95	77	29	6	15
Greensboro	88	104	95	76	30	− 3	10
Raleigh	88	103	95	78	33	− 2	15
Wilmington	87	103	95	79	38	5	20
Oklahoma							
Enid	95	113	100	75	24	−20	0
Muskogee	94	110	100	77	28	−11	− 5
Oklahoma City	92	108	95	75	27	−17	0
Tulsa	95	111	100	77	27	−16	0
Oregon							
Portland	78	104	90	66	34	− 2	15
Salem	81	108	90	63	34	− 6	10
South Carolina							
Charleston	88	104	95	80	43	7	20
Columbia	90	106	95	78	37	− 2	20
Greenville	87	106	95	76	31	− 5	10
Spartanburg	90	106	95	76	31	− 4	10
Tennessee							
Chattanooga	88	104	95	77	34	−10	10
Johnson City	88	105	95	74	28	−25	− 5
Knoxville	87	104	95	76	31	−16	0
Memphis	89	106	95	79	34	− 9	10
Nashville	89	106	95	78	31	−13	5
Texas							
Abilene	94	110	100	74	33	− 6	10
Austin	95	109	100	77	45	− 1	20
Beaumont	94	108	100	79	44	10	25
Corpus Christi	88	102	95	79	48	11	30
Dallas	94	105	100	77	36	− 3	15

Table 5—Maximum, Minimum, and Design Temperature (F deg)
(Concluded)

	Cooling				Heating		
	Av. Max.	Highest Recorded	Design Dry Bulb	Design Wet Bulb	Av. Min.	Lowest Recorded	Design
El Paso	94	106	100	70	32	− 5	15
Fort Worth	94	112	100	76	36	− 8	10
Galveston	88	100	90	79	46	8	25
Houston	93	108	100	79	44	5	20
Lubbock	92	108	95	72	25	−10	5
Port Arthur	90	102	95	79	45	11	25
San Angelo	97	110	100	73	32	1	15
San Antonio	95	107	100	77	42	4	20
Tyler	94	106	100	78	35	− 8	10
Waco	97	109	100	77	38	− 5	15
Wichita Falls	99	111	105	75	30	− 3	10

In the preparation of Table 5 design conditions were established for cities having a population over 5,000 and located in the states listed in Table 3. Only certain cities, however, are listed, but they still permit the reader to make comparisons with known local design temperatures.

cepted design temperatures fitted the curve fairly well.

Table 4 gives a number of examples of the use of Fig. 2 in comparison with recommended temperatures from a number of sources. Some anomalies among the data are indicated in the footnotes.

Column G, Table 4, was taken from Summer Weather Data,[6] Chap. 6, Table III, *Analysis of Dry Bulb Temperatures on an Eight Hour Basis*, and represents temperatures not exceeded more than 49 hours (five per cent) during the months of June through September of a normal year. The author believes that these figures, for the cities where they have been worked out, are possibly the best available. They are calculated, however, for only 67 cities in the United States.

Column H is the *Reasonable Maximum Temperature* as published by Albright,[7] who states they approximate *the peak temperature to be expected . . . in a normal year.* They are not therefore recommended dry bulb design figures but are possibly analogous to the average annual minimum shown in Column C, Table 3.

Nomograph Method Applicable to Other Cities

Comparison of recommended design temperatures from the nomograph with those from other sources indicates a correlation sufficiently close that the method can be extended to cities for which none of the authorities have published recommendations. Table 5 gives such figures to the nearest 5 deg for the same list of cities for which winter design temperatures are prepared.

While it is easily possible (as will be noted from Tables 3 and 4) to establish design temperatures to the nearest degree, custom has dictated the use of multiples of five for winter calculations, and for summer work the increase of accuracy by using integral figures is questionable. As previously mentioned, the dry bulb temperature difference is used as a base for the determination of other factors, and the easier the calculation can be made the more probable it is that some consistent plan for load calculation will be used.

Wet bulb recommendations listed in Table 5 are taken or interpolated from various sources listed in the Bibliography. It is regretted that wet bulb readings are available from so few Weather Bureau stations and that therefore the author has nothing to offer in regard to wet bulb temperature except a search of existing records. Some excellent local studies such as that by Kroeker[9] have been made.

Conclusion

The method suggested for the determination of reasonable winter and summer design temperatures, using easily available Weather Bureau data and two simple nomographs, as outlined, produces results which are in sufficiently close agreement with figures from accepted authorities to justify extending the method to communities for which Design Temperatures have not previously been published.

Bibliography

1. Heating, Ventilating, Air Conditioning Guide, 1947.

2. Climatic Summary of the United States, Weather Bureau, 1930.

3. Heating, Ventilating and Air Conditioning Fundamentals, by W. H. Severns. (John Wiley & Sons, Inc., New York, 1937.)

4. Code of Application Engineering Standards for Air Conditioning for Comfort. (*Air Conditioning and Refrigerating Machinery Association*, 1940.)

5. Heating & Ventilating Reference Data Sheet No. 57. (*Industrial Press*, 1935.)

6. Summer Weather Data. (The Marley Co., Kansas City, 1944.)

7. Analysis of Summer Weather Data in the United States, by J. C. Albright. (ASHVE Transactions, Vol. 45, 1939, p. 397.) Published also as Chap. IV, Reference 6, in this Bibliography.

8. FB—Design Weather Data. Fairbanks-Morse Co.

9. Interpretation of Summer Weather Temperature Data for Design, by J. D. Kroeker. (ASHVE Journal Section, *Heating, Piping and Air Conditioning*, July 1941, p. 450.)

Comfort Standards Feature Semi-Annual Meeting Discussions

Baldwin M. Woods
President of ASHVE

L. P. Saunders, *Chairman*
Committee on Research

WITH AN attendance of nearly 240, the Society's Semi-Annual Meeting at Hotel del Coronado, Coronado Beach, Calif., June 2-4, provided an opportunity for reviewing the current status of ASHVE research, a spirited discussion of comfort standards and physiological studies and comments on panel heating investigations. After the technical sessions, the Committee on Arrangements of the Southern California Chapter provided an enjoyable program of social and sports events.

The meeting was opened by Pres. B. M. Woods and A. E. Stacey, Jr., 2nd vice president, was introduced and conducted the first session. Art Theobald, president of the Southern California Chapter, gave a brief message of welcome to which Pres. Woods responded.

R. A. Lowe, chairman of the Committee on Arrangements, was introduced and outlined some of the special program features.

Chairman Stacey presented Cyril Tasker, director of research, Cleveland, who with the aid of slides, talked on The Challenge of the ASHVE Research Program.

H. B. Nottage, research associate at the Laboratory, presented his paper, Thermo-Physical Properties of Building Materials (to be published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*). Mr. Nottage also gave the paper, Heat Transfer by Forced Convection Along a Smooth Flat Surface, by G. V. Parmelee and R. G. Huebscher (to be published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

The concluding paper of this session, Influence of Gaseous Radiation in Panel Heating, by F. W. Hutchinson (published in the November 1946 JOURNAL SECTION, *Heating, Piping & Air Conditioning*) was presented by the author by title.

A. E. Stacey, Jr.
2nd Vice President

Promptly at 9:30 a. m. Tuesday, June 3rd, Pres. Woods opened the 2nd session of the meeting and introduced Mr. Glickman, Chicago, who gave the paper, Physiological Adjustments of Human Beings to Sudden Change in Environment, by Nathaniel Glickman, Tohru Inouye, Stanley E. Telser, M.D., Robert W. Keeton, M.D., Ford K. Hick, M.D., and Maurice K. Fahnestock (published in this issue, see p. 101).

Three papers on comfort were then given: Comfort Reactions of 275 Workers During Occupancy of Air Conditioned Offices, by F. B. Rowley, R. C. Jordan and W. E. Snyder (published in the June 1947 JOURNAL SECTION, *Heating, Piping & Air Conditioning*); Conditions for Comfort, by C. S. Leopold (published in the June 1947 JOURNAL SECTION, *Heating, Piping & Air Conditioning*); A Method for Improving the Effective Temperature Index, by C. P. Yaglou, (to be published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*). This last paper was presented by John Everetts, Jr.

On Wednesday morning President Woods introduced Prof. F. W. Hutchinson, who presented, in very brief and concise form, the paper, Experimental Studies on Panel Heating Tube Spacing, by B. F. Raber and F. W. Hutchinson (to be published in the ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

With L. P. Saunders, Lockport, N. Y., and chairman of the Committee on Research, in the chair, Professor Jennings gave the paper, Triethylene Glycol Vapor Distribution for Air Sterilization, by Edward Bigg, M.D., B. H. Jennings, and F. C. W. Olson (published in the May 1947 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

W. L. Holladay was introduced and presented the subject of Determination of Outside Design Temperatures—A Suggested Approach (published in this issue, see p. 117).

Prof. Carl Kayan, New York, presented his paper, Effect of Floor Slab on Building Structure Temperatures and Heat Flow, (published in the June 1947 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

President Woods called for the report of the Resolutions Committee which was given by C. R. Gardner, chairman, Dallas, Tex.

Council

During the days at Coronado the Council held two meetings for transacting required business and nominated candidates for the Committee on Research.

Chapter Delegates

A meeting of Chapter Delegates was held and in the absence of

Returning from the Harbor Trip

Joe Earhart greets the gang at Rosarito Beach

Art Theobald holds the Eichberg Cup

C
O
R
O
N
A
D
O

Mr. and Mrs. Leo Hungerford

Chicago to Coronado—M. W. Bishop, Mrs. Milliken, J. H. Milliken and Mrs. Bishop

John Haines plays tennis

Chairman Leser, John James, Cleveland, was selected as acting chairman.

Nominating Committee

This committee held its second meeting of the year with all but one member present and will report a slate of officers for presentation in the October JOURNAL.

Social

On Monday afternoon a large number enjoyed a sightseeing tour in San Diego and nearby points of historic interest.

The golfers went to Coronado Country Club, and M. F. Blankin carried home the Research Cup and the Southern California Chapter team captured the Eichberg Memorial Cup.

The fishermen went out in large numbers and a good catch was reported, and some good stories are being told.

Monday evening a beach party was the attraction and led by the Barber Shop Quartette, Messrs. Allen, Miller, Moffat and Snyder, everyone gathered around the fire.

Tuesday afternoon a boat trip around the bay, an inspection of the reserve fleet, and a demonstration of the Navy high altitude chambers were the featured attractions.

In the evening the Semi-Annual banquet was held and the speaker, Dr. Stafford Warren, dean of the Medical School, University of California in Los Angeles, told some of the little known details of atomic bomb effects. At the banquet Leo Hungerford was toastmaster. President Woods presented the Memory Book to Past President A. J. Offner. L. P. Saunders presented the Research Cup to M. F. Blankin, and Mr. Blankin presented the Eichberg Cup to Art Theobald, president of the Southern California Chapter.

Wednesday afternoon was the time for a trip to Mexico and 60 participated. The trip to the border was made by bus and after arrival in Tiajauna there was an opportunity to visit the shops. A Mexican bus was then used for the trip to Rosarito Beach Hotel, where a fine Mexican meal was served. For those who attended and weren't clear about the ingredients of the several dishes served, the following may be helpful:

Menu

Langosta a la Mexicana—Salsa Avocado
Soupa de Tortilla a la Sonora
Combination a la Vera Cuzana
(consisting of enchiladas, stuffed green peppers, chicken tamales, chicken tacos with chili and cheese, frijoles, and tortilla)
Crepes Suzette au Kirsh, Butterscotch
Cafe

FAUST HEADS NEW G-E DIVISION

F. H. Faust has been named manager of the newly formed Commercial Engineering Divisions of the General Electric Air Conditioning Department, according to an announcement made recently by G. R. Prout, vice president and general manager of General Electric Co.

Mr. Faust joined the Society as a Junior in 1930 and became a Member in 1936. He has written several papers on air conditioning which were presented at meetings of the Society. He has also prepared lectures for the *ASRE, AIEE* and the *ASME*, in addition to lecturing for the General Electric Company's advanced course in engineering.

H. C. BAKER DIES

Word was recently received of the sudden death on April 28, 1947, of H. C. Baker, chief engineer, Gilbert Associates, Inc., Reading, Pa.

Born June 11, 1885, in Clio, Mich., Mr. Baker studied mechanical engineering at Michigan Agriculture College (Michigan State). For 14 years he was engaged in designing heating apparatus and in estimating engineering and construction work prior to 1919 when he organized the Howard G. Baker Co. In 1944 he became associated with the Aluminum Co. of America, and in 1945 he joined the staff of Gilbert Associates, Inc., as chief engineer, building service department.

Mr. Baker had been a member of the Society for 22 years and had also been affiliated with the *American Association of Engineers.*

The Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their deepest sympathy to his widow, sister and many friends in the engineering profession.

JOURNAL SECTION

W. B. HODGE DIES AT 75

William Beach Hodge, prominent inventor, author of numerous technical papers, and former vice president of the Parks-Cramer Co., died on May 14, 1947, after a six months illness. He had been a member of the Society since 1934.

A native of Canajoharie, N. Y., Mr. Hodge received his preparatory education at Palatine Bridge high school, prior to attending Syracuse University where he received a B.S. in 1895.

His first position was with the Elmer G. Willyoung firm, Philadelphia, Pa., where he was in charge of the laboratory and finishing dept. He left this position in 1898 to join the Anaconda Copper Mining Co., Montana, as an electrical engineer in their foundry dept. Returning to Philadelphia in 1899 he joined the staff of Queen and Co., Inc. as manager of the electrical testing instrument & X-Ray dept. After a year with this company he left to become chief engineer for Stuart W. Cramer, Charlotte, N. C. Later, when the business originated by Mr. Cramer was bought by the G. M. Parks Co., Fitchburg, Mass., he became vice president of the new company.

Mr. Hodge invented jointly with Mr. Cramer, and individually, a large number of devices used in air conditioning industries, especially as relating to automatic humidity and temperature control. He made the first commercial X-Ray sold in this country and was one of the first men active in the air conditioning and humidifying of southern cotton mills. As the result of his work he was awarded the Modern Pioneer of Air Conditioning Award in 1940; and in 1945 he received an honorary degree of Doctor of Laws from Syracuse University.

He is survived by his wife, Mrs. Jessie Hodge; two daughters, Mrs. S. S. Koszeski and Mrs. J. L. Wallace; a son, Dr. Edwin S. Hodge, and two brothers, H. B. Hodge and A. E. Hodge; to whom the Officers and Council of the Society extend their deepest sympathy.

JOURNAL SECTION

Summary of Local Chapter Meetings*

ATLANTA—May 2, 1947. Subject: Energy Sources of Tomorrow. Speaker: R. A. Sherman, supervisor, fuels division, Battelle Memorial Institute, Columbus, Ohio. A discussion period followed with Mr. Sherman ably answering the many questions asked from the floor. Other Features: Reports on the status of the treasury and the fund to reduce the mortgage on the Research Laboratory building were given. The chairman of the GUIDE Committee reported on the progress his committee was making in reviewing the GUIDE, stating that he had received reports from approximately 70 members. A motion was carried that the GUIDE Committee continue its investigations. Attendance 40. Attendance ratio 0.37.

•

CENTRAL OHIO—May 19, 1947. Subject: Fiberglas Reports to the Industry. Speaker: H. A. Parson, Owens-Corning Fiberglas Corp., Toledo, Ohio. Mr. Parson traced the development of the use of glass in fiber form from the time of the Egyptians, and the progress from coarse fibers to the present stage where fibers of only 1 micron are used in aircraft insulation. An assortment of glass fiber in the form of batts, thread cloth, blankets, etc., was a special feature of this interesting presentation. Other Features: The treasurer gave his annual report, after which H. G. Hays was announced as the new treasurer to succeed Amos Potts, treasurer-elect, who resigned because of ill health. H. R. Allonier, retiring president, installed the new officers. In appreciation of his service as president, Mr. Allonier was presented with a framed scroll. Attendance 48. Attendance ratio 0.47.

•

CINCINNATI—May 6, 1947. Subject: Annual Meeting and Outing. Reports were made by the chairmen of the different committees, and A. W. Edwards, retiring president, thanked all the members for their assistance and cooperation during the past year. Tellers reported election of officers as follows: H. K. Jennings, *president;* M. E. Mathewson, *vice president;* K. B. Little, *secretary-treasurer,* E. W. McNamee as member of the *board of governors.* As his first official act, H. K. Jennings, incoming president, appointed Mr. McNamee chairman of the entertainment committee. Attendance 70. Attendance ratio 0.61.

CINCINNATI—April 1, 1947. Subject: Engineering and Engineering Education. Speaker: Ernest Szekely, member of ASHVE Council and president, Bayley Blower Co., Milwaukee, Wis. A vote of thanks was accorded to Mr. Szekely for his interesting presentation. Other Features: The president appointed a committee to audit the treasurer's accounts and report at a later meeting. The following nominations were reported for new officers: H. K. Jennings, *president;* M. E. Mathewson, *vice president;* K. B. Little, *secretary-treasurer;* W. J. Killian and E. W. McNamee, *board of governors.* Several talks were given in support of the fund to reduce the mortgage on the Research Laboratory building. Attendance 39. Attendance ratio 0.40.

•

CONNECTICUT—May 27, 1947. Subject: Fan Design and Application of Fan Equipment. Speaker: Jack Cassie, engineer, B. F. Sturtevant Co., Div. of Westinghouse Electric. An active discussion period followed this interesting lecture. Other Features: Reports were received from the different committees, after which Pres. S. R. Osborne appointed new chapter committees for 1947-48. Attendance 50. Attendance ratio 0.26.

CONNECTICUT—April 23, 1947. Subject: Engineered Air Distribution. Speaker: V. M. Lathers, Barber-Colman Co., Rockford, Ill. Mr. Lathers was thanked by the chapter for his interesting talk. Other Features: The auditor's committee reported that the treasurer's accounts had been audited and were certified correct. Pres. P. D. Bemis reported on the chapter activities of the past year and stated that membership in the chapter has increased from 72 to 95. A report was given by George Nieske on the work done during the year by the membership committee. The following officers were elected for the coming year: S. R. Osborne, *president;* E. C. Marsden, *vice president;* D. M. Hummel, *treasurer;* Winfield Roeder, *secretary;* and A. J. Lawless, member, *board of governors.* Mr. Bemis, retiring president, presented the gavel to Mr. Osborne, incoming president, who thanked the chapter for the honor given him and stated that he hoped to administer the chapter affairs in a successful year. A rising vote of thanks was given to J. R. Smak for his work on behalf of the chapter during the last six years. Attendance 77. Attendance ratio 0.30.

•

DELTA—May 13, 1947. Subject: Fluorescent Lighting. Speaker: P. W. Bordelon. Mr. Bordelon's interesting talk was followed by a discussion period. Chairmen of the various committees and the chap-

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

ter's officers reviewed the events of the past year. Newly elected officers include: J. S. Burke, *president;* L. V. Busenlener, *vice president;* F. G. Burns, *treasurer;* R. B. Guest, *secretary;* W. P. Oster, Ralph Elizardi, and James Adair, *board of governors.* Attendance 28.

•

GOLDEN GATE—May 1, 1947. Subject: Humidity and Its Control. Speaker: John Everetts, Jr., national chairman, Committee on Sorbents, and consulting engineer. Mr. Everetts illustrated his well presented talk with slides. Other Features: In his annual report, H. V. Hickman, secretary, stated that the affairs of the chapter have progressed rapidly during the past year, and the chapter was honored by having three of its members, including Dr. Baldwin M. Woods, N. H. Peterson, and John Everetts, Jr., in prominent positions in the Society. Membership in the chapter has increased during the year from 86 to 118. The drive for contributions to the retirement of the Research Laboratory mortgage also progressed favorably. Reports were also given by the different committees and considerable discussion was held regarding the provisions of a proposed Professional Engineers' Registration Act. The Tellers for the annual election announced the new officers as follows: F. W. Kolb, *president*; H. V. Hickman, *vice president*; K. F. Baldwin, Jr., *secretary*; R. C. Cushing, *treasurer*; and H. G. Smith, P. R. Babcock, John Everetts, Jr., as *board of governors.* James Gayner, retiring president, welcomed F. W. Kolb, the new president, and presented him with the charter. Attendance 59.

•

ILLINOIS—May 12, 1947. As this was the last meeting of the 1946-47 season, brief reports were given by the chairmen of the various committees. New officers were installed as follows: W. A. Kuechenberg, *president;* C. M. Burnam, Jr., *vice president;* J. S. Kearney, *treasurer;* G. W. Bornquist, *secretary;* and C. E. Crone, P. J. Marschall, J. J. Philippi and O. J. Prentice on the *board of governors.* Mr. Prentice, retiring president, presented the gavel to Mr. Kuechenberg, the incoming president. Entertainment for the evening was provided by E. Hudson, magician, and Grant Halladay, who showed a movie taken in the north woods, entitled *Holidays with the Halladays.* Attendance 121. Attendance ratio 0.31.

•

INDIANA—May 23, 1947. Subject: General Building Policy of General Motors. Speaker: F. G. Tykle, director of real estate, General Motors Corp., Detroit, Mich. Mr. Tykle outlined the general building policy of General Motors, particularly in regard to engineering problems. Other Features: President Davis informed the chapter members that I. W. Cotton and Ferdinand Jehle, alternate, will represent the Indiana chapter at the Semi-Annual Meeting in Coronado, Calif. Election of officers for the coming year was announced as follows: I. W. Cotton, *president;* P. R. Jordan, *vice president;* F. S. Boone, *treasurer;* W. R. Fenstermaker, *secretary;* G. O. Jackson, F. A. Stickle, T. R. Davis, *board of governors.* Attendance 55.

INDIANA—April 25, 1947. Subject: Regular meeting held at Purdue University, Lafayette, Ind. Members and guests inspected the following: temporary staff housing project, Purdue airport, Purdue housing research campus, solar heating research, panel heating research, Boester's play house. Later, a discussion was held on panel heating research. Nominations for officers were reported as follows: I. W. Cotton, *president;* P. R. Jordan, *vice president;* W. R. Fenstermaker, *secretary;* F. S. Boone, *treasurer;* G. O. Jackson, F. A. Stickle, Telford Davis, *board of governors.* Attendance 62.

•

IOWA—May 13, 1947. Subject: Air Pressures and Air Supply in Buildings. Speaker: W. W. Stuart, owner, Stuart Supply Co. Mr. Stuart outlined his experience, research and investigation work made on the subject of air pressures, particularly within residential buildings. Following this talk, an exceptionally interesting open forum was held, in which members discussed their experiences on this subject. Other Features: A motion was passed instructing the building code committee to cooperate with other engineering societies in securing a competent engineer as a member of the local building code council. A report on the legislative committee's meeting with the chairman of the State Building Code Central Committee was given, after which the functioning of this committee was outlined. Newly elected officers for the coming year are: C. A. Wheeler, *president;* D. C. Murphy, *vice president;* D. E. Wells, *secretary-treasurer;* W. E. Burch and R. S. Stover, *board of governors.* Attendance 19.

•

IOWA—April 15, 1947. President E. O. Olson gave a detailed, interesting report on the Society's annual meeting at Cleveland. A report was given by the legislative committee on the progress of the proposed State Building code for Iowa. Later, President Olson pointed out the three members constituting the legislative committee. A motion was carried instructing the treasurer to pay $25.00 to the Iowa Engineering Society Building Code Committee. The nominating committee reported on its recommendations of officers for the coming year. Attendance 16.

•

KANSAS CITY—May 6, 1947. Subject: Analysis of the Downward Flow of Air. Speaker: Prof. Linn Helander, Kansas State College, Manhattan, Kan. Professor Helander described his work at the college in the analysis of the downward flow of air and the development of mathematical formulas and data to accurately compute the travel and air patterns. He used slides to illustrate his talk and an active question and answer period followed. Henry Nottberg, Jr., sub-

JOURNAL SECTION

mitted his report as treasurer, and the contributions made by the chapter toward eliminating the mortgage on the Research Laboratory building were also mentioned. The nominating committee reported as follows: P. C. Leffel, *president;* Henry Gould, *vice president;* Henry Nottberg, Jr., *secretary*; Kenneth Stevens, *treasurer;* Stanley Furber, Carl Clegg, Nate Downs and W. L. Cassell as *board of governors.* A report on the program for the proposed June meeting was given by Mr. Leffel. Attendance 56.

•

MANITOBA—May 15, 1947. Subject: Radiant Panel Heating System. Speaker: J. H. Fox, Minneapolis-Honeywell Reg. Co., Ltd., Toronto, Canada. Mr. Fox stressed the control problem involved in a radiant panel heating system, illustrating his informative talk with slides. A general discussion, in which members discussed this problem, followed. Other Features: Plans for a June summer party were announced and Mr. Moore, retiring president, thanked the officers for their assistance during the year. Attendance 22.

MANITOBA—April 17, 1947. Subject: A Forum on Panel Heating. Chairman of the forum was D. S. Swain, who opened the discussion by presenting a series of charts on a large scale, outlining the procedure necessary to design a panel heating job. Other Features: The nominating committee reported on a slate of officers for the coming year. President Stephenson offered the best wishes of the chapter to F. T. Ball, who is moving to Edmonton, after which Mr. Ball thanked the president for his remarks. Attendance 26.

•

MASSACHUSETTS—May 22, 1947. Subject: Joint meeting with the *American Society of Refrigerating Engineers,* Boston section, held at Massachusetts Institute of Technology. L. R. Phillips, director of research, Anemostat Corp. of America, New York, N. Y., spoke on the Science of Air Diffusion. Attendance 102.

•

MEMPHIS—May 19, 1947. W. L. Henson, retiring treasurer, submitted his report for the year, including the contributions for the Research Laboratory mortgage retirement fund. An auditing committee was appointed to examine the treasurer's books and report at the June meeting. T. O. S. Humphrey, Jr., was nominated to serve as a member for three years on the board of governors. The new board of governors consists of R. H. Hoshall, T. O. S. Humphrey, Jr., J. B. Lammons and W. E. Thorpe. The meeting concluded with a showing of an animated sound movie entitled *Weather by Carrier.* Attendance 22. Attendance ratio 0.55.

MEMPHIS—April 21, 1947. Subject: Radiant Heating. Speaker: P. S. Park, Jr., A. M. Byers Co., Pittsburgh, Pa. Mr. Park illustrated the important points made during his talk with slides. A general discussion period followed. Other Features: N. C. Ledbetter was chosen as delegate to the Semi-Annual Meeting and a motion was carried that the chapter pay his expenses. W. L. Henson, treasurer, reported on the contributions made by members toward reducing the mortgage on the Research Laboratory building. The following were chosen as officers for the coming year: N. C. Ledbetter, *president;* E. E. Scott, *vice president;* Alex T. Bevil, *secretary;* Carl Fischer, *treasurer.* Attendance 25. Attendance ratio 0.64.

•

MICHIGAN—May 23, 1947. Subject: Annual Meeting. F. R. Bishop, retiring president, thanked the officers and committees for the splendid cooperation given him during his term in office. A committee to audit the retiring treasurer's books and report at the next meeting was appointed. Election of officers was announced as follows: A. E. Knibb, *president;* E. F. Hyde, *vice president;* L. A. Burch, *secretary;* C. F. Donohoe, *treasurer;* G. W. Akers, T. H. Mabley, and R. H. Oberschulte, *board of governors.* The retiring president turned the meeting over to Mr. Knibb, newly elected president, who introduced the new officers. The president's memory book was presented to Mr. Bishop, who thanked the members for this remembrance. An inscribed leather pocket case was presented to G. D. Winans in appreciation for his efforts over many years in preparing a memory book for the retiring president. Attendance 56.

•

MINNESOTA—May 5, 1947. Subject: Panel Heating Control. Speaker: J. E. Haines, vice president, Minneapolis - Honeywell Regulator Co., Minneapolis, Minn., and president of Minnesota Chapter. Mr. Haines mentioned a new approach to the problem of panel heating design and used slides to illustrate a number of control arrangements. A discussion period followed his interesting presentation. Other Features: A report on the contributions made toward eliminating the Research Laboratory mortgage was given, after which President Haines introduced his guest, W. R. Moore of the Northern Ohio Chapter, who invited the Minnesota Chapter members to visit the Laboratory in Cleveland. B. F. McLouth announced that an all time high of 71 new members had been obtained by the membership committee. A warm air heating conference scheduled for Minneapolis in May was announced. The new officers for the coming year include: L. C. Grost, *president;* O. L. Lilja, *vice president;* L. J. Krause, *secretary;* E. J. Uhl, *treasurer;* Guy M. Brown, J. F. Stafford and John E. Haines, *board of governors.* F. B. Rowley was elected chapter representative to the Minnesota Federation of Engineering Societies with C. E. Gauman serving as alternate. Attendance 102.

•

MONTREAL—May 19, 1947. Subject: Informal Stag Affair, held at the Edgewater Beach Hotel, Pointe Claire. A round table discussion

was held and members provided their own entertainment. Since this was a social meeting, no business was transacted. Attendance 26.

MONTREAL—April 21, 1947. Subject: Industrial Air Conditioning Applications. Speaker: A. E. Stacey, Jr., process consultant, sales div., Carrier Corp., Syracuse, N. Y. Mr. Stacey discussed the development of air conditioning design, with special reference to the textile industry. He also discussed several other industrial processes. The members indicated their interest in this subject in the lively discussion period which followed. Other Features: The March minutes were approved without reading, and a report was given on the progress of the drive to eliminate the mortgage on the Research Laboratory building. Attendance 89.

•

NEBRASKA—May 6, 1947. K. R. Magarrell, treasurer, gave a final financial report for the year, stating that all dues had been paid. Officers for the coming year were announced as follows: Verne Simmonds, *president;* Kenneth Magarrell, *vice president;* G. W. Colburn, *secretary;* and C. A. Carter, *treasurer.* Henry Kleinkauf, retiring president, thanked his officers and the members for the fine cooperation he had received from them during the past year. He also asked members who had not yet contributed to the fund to reduce the Research Laboratory mortgage to try and do so in the near future. A brief discussion was held concerning the possibility of any members attending the Semi-Annual meeting of the Society in Coronado, Calif. Attendance 14.

•

NEW YORK—April 21, 1947. Subject: Is Radiant Cooling Practicable? Speaker: Prof. C. P. Yaglou, associate professor of industrial hygiene, Harvard School of Public Health, Cambridge, Mass. Professor Yaglou described tests which were conducted some years ago by Dr. Oscar Schneider and himself to determine whether comfort could economically be maintained with high summer temperatures and humidities and without entrance and exit *shock.* Following a lively discussion period, a rising vote of thanks was given to Professor Yaglou for a very interesting and instructive evening. Other Features: New chapter members were introduced by membership chairman Floyd Lawrence. The auditing committee reported that the books of the treasurer had been audited and found in good order. Officers for the coming year were elected as follows: M. C. Giannini, *president;* A. A. Bearman, *vice president;* W. M. Heebner, *treasurer;* Carl H. Flink, *secretary;* P. B. Gordon, Ernst Graber, H. S. Johnson, C. F. Kayan, and W. A. Sherbrooke, *board of governors.* Attendance ratio 0.31.

•

NORTHERN OHIO—May 12, 1947. Subject: Operation of a New Air Conditioning Unit. Speaker: Fred Johnson, Surface Combustion Corp., Toledo, Ohio. Mr. Johnson explained the operation of a development for providing year-round air conditioning in the home and showed slides to illustrate the construction and air travel through this unit. A discussion period followed this interesting talk. Other Features: C. W. Knight presented a brief *coffee talk* on the latest developments in the construction of a lake front airport. Brief reports were received from the publicity, meetings and mortgage retirement committees. The various programs held during the year were reviewed. The following have been selected for chapter officers during the coming season: John W. James, *president;* W. R. Moore, *vice president;* W. M. Rowe, *secretary;* John Richmond, *treasurer;* J. E. Wilhelm, R. L. Byers, C. M. Humphreys, *board of governors.* President Wilhelm thanked the committee chairmen and officers for their assistance throughout the year and expressed his appreciation for the certificate presented to him by the officers and board of governors. Attendance 105. Attendance ratio 0.63.

•

NORTH TEXAS—May 19, 1947. Subject: Student Selection and Guidance. Speaker: C. J. Eckhardt, Jr., professor, mechanical engineering and supt. of utilities, University of Texas, Austin, Tex. Professor Eckhardt pointed out the importance of proper counsel and guidance of the student engineer in the early stages of his education, and mentioned some of the methods used by present-day educational institutions to determine a student's aptitude for his chosen profession. Other Features: The financial status of the chapter was discussed and plans were formulated for a summer social meeting. Attendance 53.

JOURNAL SECTION

•

OKLAHOMA—May 19, 1947. Subject: Coil Selection. Speaker: E. A. Rapp, General Electric Co., Dallas, Tex. General discussion followed Mr. Rapp's interesting talk. Contributions for the new Research Laboratory building at Cleveland were discussed, and it was the consensus of the members that this money should be raised by private contributions. Officers for the coming year include: W. W. Frankfurt, *president;* W. M. Carroll, *vice president;* J. H. Spann, Jr., *secretary-treasurer;* E. F. Dawson, G. T. Donceel, C. Y. Trowbridge, *board of governors.* Attendance 15.

OKLAHOMA—April 14, 1947. Subject: Electronic Air Cleaning—Theory and Practice. Speaker: J. W. May, director of research, American Air Filter Co., Louisville, Ky. During his talk, Mr. May demonstrated a working model of a new electronic air filter. A general discussion period followed. Attendance 76.

•

ONTARIO—May 5, 1947. Reports were given by the chairmen of the various committees. H. H. Angus reported that the University of Toronto Award for this year was given to J. D. Baker. It was determined that the officers solicit funds from individual members on a voluntary basis to pay for the refresh-

ment expenses. Officers for the coming year were elected as follows: D. A. Stott, *president;* E. G. Spall, *vice president;* H. R. Roth, *secretary-treasurer;* A. J. Strain, William Philip, J. H. Fox, V. J. Jenkinson, ex-officio, *board of governors.* Attendance 54.

•

OREGON—May 8, 1947. Bob Wettstein, the Society's western advertising representative, presented greetings from the Los Angeles chapter and an invitation to attend the Semi-Annual meeting at Coronado, Calif. President Brissenden appointed the committees for the year, and the chairmen of the various committees gave their reports. Past President Bruce Morrison presented an engraved gavel to Past President Frank Urban, the chapter's charter to President Brissenden, and a framed copy of the chapter's Creed to J. D. Kroeker, the chapter's first president. This copy had been originally presented to the chapter by the Washington, D. C., chapter. R. C. Chewning was chosen to act as alternate delegate to the summer meeting at Coronado, Calif. A discussion was held on the next air conditioning conference to be held by the chapter. Attendance 58.

•

PACIFIC NORTHWEST—May 13, 1947. Subject: Inspection and Talks on Boeing Aircraft Wind Tunnel. Speakers: Lloyd Goodmanson, senior aerodynamacist, and Norman Moreland, wind tunnel maintenance supervisor, Boeing Aircraft Co. Mr. Goodmanson described the methods now utilized by the company for testing future aircraft structures in their wind tunnel. He described how actual flight conditions were duplicated, stating that an air speed of 744 mph has been attained in this tunnel. Mr. Moreland discussed in detail the wind tunnel equipment operation and maintenance. At the conclusion of these informative talks, a visit was made to the wind tunnel, where both Mr. Goodmanson and Mr. Moreland demonstrated its operation. Other Features: New officers for the coming year were announced: E. H. Langdon, *president;* L. L. Bysom, *vice president;* E. J. Rosen, *secretary;* J. D. Sparks, *treasurer.* Attendance 21.

•

PHILADELPHIA—May 20, 1947. Annual Meeting and Golf Outing. The reading of the minutes of the last meeting and the treasurer's report was dispensed with. M. G. Kershaw, retiring president, introduced President-elect E. H. Dafter, and the other newly elected officers for 1947-48. In appreciation of his work during the past year, R. D. Touton, past president, presented M. G. Kershaw, retiring president, with a bronze plaque bearing the symbol of the ASHVE. Attendance 115. Attendance ratio 0.61.

•

PITTSBURGH—May 12, 1947. President Nass discussed the fund to aid in eliminating the mortgage on the Research Laboratory building. Officers elected for the coming year include: D. W. Loucks, *president;* H. E. Park, *vice president;* B. B. Reilly, *treasurer;* E. H. Riesmeyer, Jr., *secretary;* C. H. Schneider, E. C. Hach and A. F. Nass, *board of governors.* A. F. Nass, retiring president, reviewed the events of the past year and asked the members to continue on in the support of the new president, D. W. Loucks. After receiving the gavel, President Loucks spoke of the possibilities for the future and hoped that all members would cooperate if they were called to serve on committees. Attendance 51. Attendance ratio, 0.67.

•

SOUTH TEXAS—May 16, 1947. Subject: Reflections on Selling. Speaker: William Boyd. After it was announced that Lloyd Howell, who has been a member in good standing since 1915, has been given a Life Membership in the Society, a rising ovation was accorded him. Four members stated that they expect to make the trip to Coronado, Calif., for the Society's summer meeting. Election of new officers was announced as follows: D. M. Mills, *president;* C. C. Quin, *vice president;* L. L. Ladewig, *secretary;* R. J. Salinger, *treasurer;* C. L. Boehler and F. C. Brandt, *board of governors.* B. P. Fisher, retiring president, thanked his entire staff and committees for their fine outstanding work during his tenure of office and wished the incoming president all possible success, offering him any assistance that could be rendered. Mr. Fisher then turned the gavel over to the newly elected president, D. M. Mills, to continue the meeting. Arrangements for the June meeting were announced and reports were received from the different committees. President Mills asked for a rising vote of thanks and ovation for the outgoing officers and committees. Attendance 68.

SOUTH TEXAS—April 25, 1947. Subject: Distribution—Duct Design in Air Conditioning. Speakers: R. H. Wittbold, district representative for Barber-Colman Co.; C. L. Kribs, Jr., engineer, Houston; F. C. Brandt, engineer, Minneapolis-Honeywell Regulator Co.; B. J. Beaird, chief engineer, Charles G. Heyne & Co. I. A. Naman outlined the important points made by the various speakers in closing the discussion. Other Features: R. F. Taylor reported on the Council meeting in Chicago, following which reports were given by the membership and the classification committees. A group of 30 A. & M. college students, who were the guests of the chapter, were introduced by President Fisher. W. E. Long, of the A. & M. College, announced the program of an air conditioning conference scheduled at the College June 9-11. Attendance 122.

•

SOUTHERN CALIFORNIA—April 9, 1947: Subject: Nine Basic Requirements for Any Air Conditioning System. Speaker: C. L. Ringquist, manager, air conditioning div., The Trane Co. Mr. Ringquist discussed the basic requirements for any air conditioning system, particularly in regard to a fan system, individual

room units, and a combination system. Other Features: A resolution was approved to have the secretary inform the Los Angeles Engineering Council and the state legislators from Los Angeles County that the chapter is in favor of a bill known as the Registration Bill for Professional Engineers. A report was given on a meeting which had been held with the State Contractors' Licensing Board. Mr. Evans presented an original program of the first Southern California Chapter meeting to the chapter for its permanent archives. Attendance 90.

•

ROCKY MOUNTAIN—May 7, 1947. Subject: Central Heating Applications to Small and Large Communities. Speaker: Warner O. Entenmann, Ric-WiL Co., Cleveland, Ohio. Other Features: Reports were given by the membership, code, and program committees. Dan McQuaid suggested that a definite student night for student engineers at the universities be appointed. Attendance 28.

•

WASHINGTON, D. C.—May 14, 1947. Subject: Possibilities of Practical Heat Engineering in Research. Speaker: S. F. Reed, president, Reed Research, Inc., Washington, D. C. At the conclusion of Mr. Reed's interesting talk a movie entitled *Mr. Bell* was shown by the Telephone Co. Other Features: Committee reports were heard, and F. A. Leser read the minutes of the Chapter Delegates Committee at the Annual Meeting. L. Bert Nye, Jr., retiring president, gave a brief report on the Society's activities during the year. Officers elected for the coming year are: H. H. Hill, *president;* A. S. Gates, Jr., *vice president;* J. G. Muirheid, *secretary;* P. R. Achenbach, *treasurer;* L. Bert Nye, Jr., A. C. Crawford, J. C. Benson, as *board of governors.* The retiring president, Mr. Nye, turned the meeting over to Mr. Hill, newly elected president, who introduced the other new officers. Attendance 68.

WASHINGTON, D. C.—April 9, 1947. Subject: Inspection of the Pentagon Building. C. B. Overman, building superintendent, gave a very interesting talk on the construction and operation of the building. J. A. Velardi, chief mechanical engineer, discussed in detail the ventilating and air conditioning, illustrating his talk with working models of the electronic and pneumatic control systems. The members and guests were taken on an inspection tour of the building, which included a trip through the tunnel to the heating and cooling plant. The following were nominated for officers for the 1947-48 season: H. H. Hill, *president;* A. S. Gates, Jr., *vice president;* J. G. Muirhead, *secretary;* P. R. Achenbach, *treasurer;* L. Bert Nye, Jr., A. C. Crawford, and J. C. Benson, *board of governors.* Attendance 110.

•

WESTERN MICHIGAN—April 16, 1947. Subject: Technology Tomorrow. Speaker: Dr. Baldwin M. Woods, president of the ASHVE and director, university extension, University of California, Berkeley, Calif. Dr. Woods enumerated some of the significant inventions of the past century, pointing out that all of these inventions have caused the growth of large industries and helped eliminate physical labor. He also discussed possible inventions of the future. Dr. Woods prefaced his talk with a discussion of some of the problems and methods involved in the operation of the National Society, and mentioned some of the aims of the Research Laboratory in connection with the fund for eliminating the mortgage on the new laboratory. Other Features: Reports were given by the treasurer and the chairman of the annual chapter meeting. The nominations for new officers include: Frank Harbin, *president;* H. W. Wolters, *vice president;* W. DeRoo, *secretary;* C. A. Simonds, *treasurer;* J. W. Miller, K. E. Robinson, and H. R. Limbacher, *board of governors.* Attendance 63.

•

WESTERN NEW YORK—May 12, 1947. The treasurer's report was read and accepted. L. P. Saunders presented a highly interesting report on the work of the National Committee and of the Research Laboratory in Cleveland. Two sound films were shown, *The Story of Wrought Iron,* by the A. M. Byers Co., and *The Atomic Bomb,* by The March of Time. Officers for the coming year were announced, and G. E. Adema, newly elected president, appointed the committees for the coming year. Attendance 32.

WESTERN NEW YORK—April 14, 1947. A discussion of the problems connected with the retirement of the mortgage on the Research Laboratory building was held, after which Joseph Davis was appointed chairman of a subscription committee and members were urged to give this matter their full support. Nominations for new officers were reported and approved as follows: George Adema, *president;* Edwin Woolcock, 1*st vice president*; F. J. Weber, 2*nd vice president;* B. C. Candee, *treasurer;* John Bryce, *secretary.* Attendance 25.

•

WISCONSIN—April 15, 1947. Subject: The Effect of Man's Inventions on Our Daily Lives and Technology of the Future. Speaker: Dr. Baldwin M. Woods, president of the ASHVE and director, university extension, University of California. Dr. Woods discussed the effect that major inventions, since the turn of the century, have played on our lives, illustrating each with specific examples, and indicated how these inventions, as well as many others, may be improved in the future. He also described the process of inventing a new product and the features and time required to successfully develop this product. Other Features: The program committee announced the speaker for a future meeting and a report was given on membership. The nominees for officers for the 1947-48 season include: Rex Vernon, *president;* W. A. Ouweneel, *vice president;* W. H. Stevens, *treasurer;* B. M. Kluge, *secretary;* E. W. Gifford, I. J. Haus,

and H. W. Schreiber, *board of governors.* Attendance 88.

Student Branch

TEXAS A. & M.—May 15, 1947. The chairman of the placement committee reported on the progress of his committee, after which Pres. H. M. Kay expressed the gratitude of the members to M. J. McCall and W. A. Collins for the excellent work they did in promoting an exhibit on Engineers' Day, May 10. All students who will be present at the college during the summer were urged to attend the Air Conditioning Conference scheduled at the college June 9-11. The following were elected officers for the coming school year: G. H. Jackson, *president;* S. E. Ammons, *vice president;* T. V. Burns, *secretary-treasurer;* M. L. Brown, *reporter and publicity chairman.* Attendance 39.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 106 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by July 25, 1947, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ADAMS, ROBERT R., Supvsr. Engr., The Gilson Manufacturing Co., Ltd. PROPOSERS: W. H. Evans, William Philip. SECONDERS: T. H. McLaren, J. A. Clifton.

AHLRICHS, HERMAN, Owner, H. Ahlrichs Plumbing & Heating Co. PROPOSERS: Nicholas Magnusson, Andrew Wilson*. SECONDERS: Walter Flower*, C. H. Werkerle*.

ALLEN, W. T., Supt., Htg. & Plbg. Dept., Royal Canadian Engineers. PROPOSERS: C. W. Johnson, G. E. Smith. SECONDERS: W. R. Totten*, H. R. Roth.

AMINOFF, EUGEN, Mgng. Dir., Varme & Sanitetsaktiebolaget Ido. PROPOSERS: L. J. Whelan, Harald Ericsson. SECONDERS: Nikolai Alfsen, William Fitzgibbons*.

ANDERSON, ERIK A., Asst. Dist. Engr., B. F. Sturtevant Co., Div. of Westinghouse Electric. PROPOSERS: W. L. Hunken, H. W. Reil. SECONDERS: Leo Sudderth, Jr., W. M. Garrard.

ANGLIN, THOMAS G., Cons. Engr., T. G. Anglin Engineering Co., Ltd. PROPOSERS: S. W. Salter, Aylmer Hamlet. SECONDERS: Leo Garneau, A. B. Madden.

ANTHONY, WILLIAM R., Supt., Anthony Company. PROPOSERS: Buster Welch, W. H. Curry. SECONDERS: G. A. Linskie, M. A. Benson.

ARNOLD, JONAH S., Htg. & Vent. Draftsman & Designer, Parsons, Brinckerhoff, Hogan & MacDonald. PROPOSERS: E. B. Johnson, F. X. Ficarra. SECONDERS: Armand Cowan, N. S. Zaleiko*.

AVERY, EDWARD G., Sales Engr., Sarco Co., Inc. PROPOSERS: A. H. Blaker, J. M. Roche. SECONDERS: A. O. May, W. A. Kuechenberg.

BACHMANN, WILLIAM L., Tucker & Rice, Inc. PROPOSERS: J. W. Walsh, R. T. Kern. SECONDERS: W. H. Dolan, G. B. Torrens.

BAILEY, FRED N., Indus. Engr., Harris Pump & Supply Co. PROPOSERS: T. F. Campbell, H. E. Park. SECONDERS: E. C. Smyers, J. L. McCann.

BARBECK, WILLIAM R., Partner, Rodgers-Barbeck Co. PROPOSERS: Herman Blum, George Landauer. SECONDERS: W. H. Moler, M. L. Brown.

BOWMAN, MURRAY K., Service Mgr., Perfex Controls Ltd. PROPOSERS: E. G. Spall, V. J. Jenkinson. SECONDERS: R. S. Mathison, D. A. Stott.

BROWN, MORRIS, Engr., Bldg. Service Div., Stone & Webster Engineering Corp. (*Reinstatement & Advancement*) PROPOSERS: H. S. Cole, E. L. Blair. SECONDERS: D. W. Blair, W. H. Shipp.

BROWN, NORMAN L., Field Service Engr., A. M. Byers Co. PROPOSERS: W. F. Ryan, W. T. Conroy. SECONDERS: E. W. Lochman, P. C. Leffel.

BURNS, THOMAS V., JR., Student, Texas A & M College. PROPOSERS: J. S. Hopper, W. E. Long. SECONDERS: E. S. Holdredge*, R. M. Wingren*.

BURT, RALPH L., Engr., Charles S. Besser Co. PROPOSERS: W. W. Berger, C. Z. Adams. SECONDERS: R. A. Stipp, W. D. Graham.

CARLSEN, HOWARD J., Student, Michigan College of Mining & Technology. PROPOSERS: F. C. Wittig, E. W. Niemi*. SECONDERS: G. W. Swenson*, A. P. Young*.

CAUGHMAN, RICHARD B., Airtemp Tech., Export Div., Chrysler Corp. PROPOSERS: K. L. Crape*, H. P. Stewart*. SECONDERS: T. B. Hollencamp*, D. D. Curtis*.

COLE, HAROLD W., Student, David Ranken Jr. School of Mechanical Trades. PROPOSERS: J. T. Lynch, G. B. Rodenheiser. SECONDERS: H. C. Sharp, James Barry, Jr.

CONRAD, ALTON F., JR., Engr., Avery Engineering Co. PROPOSERS: J. E. Wilhelm, R. L. Byers. SECONDERS: D. L. Taze, D. E. Mannen.

DICKSON, ROBERT W., Field Engr., American Blower Corp. (*Advancement*) PROPOSERS: G. G. Waters, F. C. McIntosh. SECONDERS: R. J. J. Tennant, W. M. Rowe.

DIRECTOR, ISADORE, Engr., L. S. Tarleton. (*Advancement*) PROPOSERS: R. H. Smiles, E. H. Dafter. SECONDERS: R. F. Hunger, S. E. Plewes.

*Non-member.

OREMUS, LEROY A., Combus. Engr., Standard Oil Company of Brazil. PROPOSERS: B. J. Cross*, P. B. Place*. SECONDERS: A. R. Mumford*, G. D. Winans.

ORFFI, ARTHUR A., Student, Michigan College of Mining & Technology. PROPOSERS: F. E. Wittig, E. W. Niemi*. SECONDERS: S. W. Swenson*, A. P. Young*.

UKELOW, JAMES S., Mech. Coordinator, Long Construction Co. PROPOSERS: W. L. Cassell, C. A. Weiss. SECONDERS: Carl Clegg, F. A. Sheppard.

RIKSEN, WILBUR R., Pres., Airgram Corp. PROPOSERS: J. W. McGuire, H. J. Ryan. SECONDERS: G. J. Sweeney, A. Gramsaglea*.

AIRCHILD, HAROLD P., Field Engr., Frank A. McBride Co. PROPOSERS: E. T. Best, F. P. Montesano. SECONDERS: H. E. Hoertel, J. N. McBride.

LARSHEIM, CLARENCE A., Repr., Binks Manufacturing Co. (*Advancement*) PROPOSERS: E. K. Campbell, N. W. Downes. SECONDERS: Carl Clegg, B. F. Cook.

RICKE, ROBERT A., Student, Michigan College of Mining and Technology. PROPOSERS: F. E. Wittig, A. P. Young*. SECONDERS: V. O. York*, R. R. Seeber*.

AINES, E. F., Vice-Pres., Joplin Cement Co. PROPOSERS: J. T. Jones, D. M. Allen. SECONDERS: H. A. Satterlee, Earle McMullen.

ASKELL, WILLIAM, JR., Dvlpt. Engr, The Miller Co. PROPOSERS: G. F. Nieske, J. R. Howard. SECONDERS: Winfield Roeder, S. R. Osborne.

RAHAM, WILLIAM D., JR., Sales Engr., The Trane Co. PROPOSERS: W. D. Graham, C. Z. Adams. SECONDERS: Karl Selden, Jr., M. F. DuChateau.

ALL, ROBERT S., Sales Engr., Companhia Industria e Comercio Glossop. PROPOSERS: Arvin Page, DeParx Stimson. SECONDERS: L. H. Allcorn, Jr., C. C. Cornwall.

ALL, ROGER E., Engr., Alhambra Sheet Metal Works. PROPOSERS: Leo Hungerford, L. J. Helms. SECONDERS: J. B. Venneman, R. J. Petersen.

ALSTEAD, WILLIAM R., Student, Georgia School of Technology. PROPOSERS: J. A. Sheahan, O. C. Riggs. SECONDERS: L. D. Wagner, D. D. Beach*.

ARRIS, WALLACE L., Engrg. Estimator, Harris Brothers Plumbing Co. PROPOSERS: A. B. Algren, C. W. Larson. SECONDERS: J. E. Haines, O. L. Lilja.

EIKKINEN, HENRY K., Instructor, The William Hood Dunwoody Industrial Institute. PROPOSERS: F. H. Schneeberg, B. F. McLouth. SECONDERS: R. T. Haley, J. A. Sandberg.

CKEY, DANIEL E., Owner. PROPOSERS: H. E. Park, O. L. Williams. SECONDERS: R. J. Doherty, A. F. Nass.

OFF, OLIVER I., Student, Michigan College of Mining & Technology. PROPOSERS: F. E. Wittig, A. P. Young*. SECONDERS: V. O. York*, R. R. Seeber*.

OLLIDAY, FRANK R., JR., Design Mgr., F. R. Holliday & Co. PROPOSERS: M. F. DuChateau, G. B. Rottman. SECONDERS: C. Z. Adams, P. L. Guest, Jr.

OLLIDAY, FRANK R., Operator, F. R. Holliday & Co. PROPOSERS: M. F. DuChateau, G. B. Rottman. SECONDERS: C. Z. Adams, P. L. Guest, Jr.

OWELL, EDWARD L., Partner, Howell Engineers. PROPOSERS: R. F. Taylor, R. J. Salinger. SECONDERS: H. L. DeVine, C. S. Woodruff.

UCKINS, EDWARD R., Student, The William Hood Dunwoody Industrial Institute. PROPOSERS: F. H. Schneeberg, H. K. Heikkinen. SECONDERS: R. T. Haley, B. F. McLouth.

OHNSON, ENAR A., Engr., G. M. Orr Engineering Co. PROPOSERS: E. J. Uhl, G. M. Orr. SECONDERS: R. J. Ruth, W. F. Uhl.

OANE, JAMES M., Student, Case Institute of Technology. PROPOSERS: G. L. Tuve, L. G. Seigel. SECONDERS: W. L. Bryan, D. K. Wright, Jr.*

OELER, FORREST E., Sales Engr., C. W. Parsons Inc. PROPOSERS: R. A. Lowe, J. D. Owen. SECONDERS: J. S. Earhart, C. W. Pollock.

KELAHAN, JOSEPH R., JR., Repr., C rk Insulation Co., Inc. PROPOSERS: James Gayner, R. C. Cushing. SECONDERS: H. V. Hickman, H. R. Scandrett.

KENNICOTT, CHARLES W., Secy.-Treas., Engineered Equipment Corp. PROPOSERS: R. A. Lowe, Leo Hungerford. SECONDERS: Art Theobald, Maron Kennedy.

KERR, JAMES W., Student, Texas A & M College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: E. S. Holdredge*, R. M. Wingren*.

KINSINGER, ROSS E., Htg. Engr., Page Hersey Tubes Ltd. PROPOSERS: W. A. Connor, J. H. Ross. SECONDERS: J. H. Robinson, Samuel Crump.

KLUGER, EDWIN C., Sales Engr., Jas. P. Marsh Corp. PROPOSERS: W. N. Donelson, Dennis Boggs. SECONDERS: E. E. Maurer, J. M. Black.

KOCH, JOSEPH J., Partner, J. F. Shelton Co. PROPOSERS: J. B. Lammons, A. T. Bevil. SECONDERS: H. H. Wilson, C. S. Fischer.

KREISMAN, HERBERT, Vice-Pres., Advance Heating & Air Conditioning Corp. PROPOSERS: S. L. Haas, C. W. Johnson. SECONDERS: C. W. DeLand, C. M. Burnam, Jr.

KROGMAN, WESTON L., Acting Supt., Dept. of Bldgs. & Grounds, The University of Chicago. PROPOSERS: J. C. Matchett, L. S. Ries. SECONDERS: J. J. Philippi, S. R. Lewis.

KUHLMAN, CHARLES E., Student, Michigan State College. PROPOSERS: C. H. Pesterfield, L. G. Miller. SECONDERS: J. W. Miller, K. E. Robinson.

KUN, IRVING B., Mech Engr., L. S. Tarleton. PROPOSERS: Isadore Director*, R. H. Smiles. SECONDERS: E. H. Dafter, R. F. Hunger.

LACY, JAMES W., Asst. Prof. of Mech. Engrg., Southern Methodist University. PROPOSERS: D. C. Pfeiffer, Ross Zumwalt. SECONDERS: P. N. Vinther, Claude Yost.

LAMB, JORDAN H., Htg., Vent. & Air Cond. Engr., Twin Coach Co. PROPOSERS: John Frisse, W. M. Rogers. SECONDERS: W. F. Gerhauser*, J. R. Venning.

LARKIN, JOHN A., Sr. Sales Engr., Energy Control Co. PROPOSERS: D. M. Hummel, P. D. Bemis. SECONDERS: L. A. Teasdale, J. R. Smak.

LOWE, JOHN B., Pres., Texas Distributors, Inc. PROPOSERS: J. A. Ray, E. T. Gessell. SECONDERS: J. D. Poythress, D. W. Harrington.

LUND, JOHN F., Sales Mgr., Plbg. & Htg. Div., The Dole Valve Co. PROPOSERS: W. G. Boales, E. N. McDonnell. SECONDERS: J. E. McDonnell, R. E. Moore.

MAULDIN, JOHN G., Partner, Mauldin & Bailey. PROPOSERS: P. E. Gregory, J. A. Sheahan. SECONDERS: L. D. Wagner, I. Keith*.

MCCULLOUGH, G. W., Sales Engr., Electronic Supply & Engineering Co. PROPOSERS: D. S. Cooper, R. H. Wittbold. SECONDERS: F. C. Brandt, D. M. Mills.

MCGAVOCK, EDWARD A., Sales Engr., Forest City Heating Co. PROPOSERS: I. A. Planck*, E. S. Tuck*. SECONDERS: R. E. Gallatin*, F. C. Mason*.

MCKEE, THOMAS M., JR., Partner, J. F. Shelton Co. PROPOSERS: J. B. Lammons, A. T. Bevil. SECONDERS: H. H. Wilson, C. S. Fischer.

MCKIE, THOMAS G., Student, Michigan College of Mining and Technology. PROPOSERS: F. E. Wittig, A. P. Young*. SECONDERS: V. O. York*, R. R. Seeber*.

MEIDENBAUER, PHILLIP E., JR., Owner, Firewel Co. PROPOSERS: Herman Seelbach, Jr., W. H. Stell, Jr. SECONDERS: P. S. Hedley, Q. P. Thompson.

MEYER, ROBERT P., Student, Purdue University. PROPOSERS: W. T. Miller, F. W. Hutchinson. SECONDERS: C. F. Warner, H. G. Venemann.

MILLER, KENNETH W., Mech. Engr., Grudem Bros. Co. PROPOSERS: H. R. Nichols, R. H. Lee. SECONDERS: J. A. Craig, L. C. Gross.

MOORE, ALEXANDER G., Cons. Engr. PROPOSERS: J. P. Keith, J. R. Auld*. SECONDERS: H. C. Karn*, John Missler*.

MURPHY, GEORGE R., Mfrs. Agent. PROPOSERS: F. J. Ward, A. W. Edwards. SECONDERS: I. G. Edwards, J. E. Allan.

MURRAY, FRANK L., Owner, Murray Engineering Co. PROPOSERS: Frank Harbin, A. H. Snook. SECONDERS: R. B. Smith, L. A. Tilford.

NEUMAN, STEVEN I., Sr. Tech. Asst., W. H. Brady & Co., Ltd. PROPOSERS: H. W. J. Lipscombe, G. R. Beavers. SECONDERS: V. A. Kennett, S. Hicks*.

OLSON, WILLARD A., Vice-Pres., Electro Specialty Manufacturing Co., Inc. PROPOSERS: E. M. Wiik, A. B. Algren. SECONDERS: H. C. Mills, J. E. Haines.

PARKER, GARRETT S., Sales Engr., C. A. Dunham Co. PROPOSERS: O. J. Prentice, C. M. Brigham. SECONDERS: C. M. Burnam, Jr., C. E. Price.

PHILLIPS, ERIC G., Partner, E. G. Phillips Son & Norfolk. PROPOSERS: C. P. How, S. F. Greenland. SECONDERS: R. E. Otter, T. N. Adlam.

RAY, GEORGE A., Sales Engr., Horne-Wilson, Inc. PROPOSERS: B. A. Thomas, H. G. Carter. SECONDERS: R. A. Menendez, G. P. Patterson.

REED, VERNON E., JR., Draftsman, A. M. Strauss. PROPOSERS: J. D. Pressler, W. R. Sinish. SECONDERS: E. R. Anderson, E. H. Hattersley.

RUSSELL, HAROLD E., Htg. Engr. & Supvsr., Cincinnati Gas & Electric Co. PROPOSERS: A. W. Edwards, K. B. Little. SECONDERS: O. W. Motz, E. W. McNamee.

SCHENCK, WILLIAM P., Chief Engr., Petrol Corp. PROPOSERS: C. W. Whitney, T. H. Smoot. SECONDERS: E. J. Meloney, F. C. Haab*.

SCHILKEN, DONALD R., Indus. Sales Mgr., Alexander-Stafford Corp. PROPOSERS: T. D. Stafford, F. C. Warren. SECONDERS: Lewis Van Spriell, S. H. Downs.

SHEPARD, L. WARREN, Sales Engr., Minneapolis-Honeywell Regulator Co. PROPOSERS: J. R. Howard, Winfield Roeder. SECONDERS: P. D. Harrigan, G. F. Nieske.

SIMPSON, EDWARD H., Design Engr., Cargocaire Engineering Corp. PROPOSERS: F. J. Swaney, A. A. Bearman. SECONDERS: C. W. Stewart, J. W. Markert.

SINGER, G. G., Pres., Atlas Industries Ltd. PROPOSERS: J. P. Fitzsimons, A. B. Madden. SECONDERS: Leo Garneau, Aylmer Hamlet.

SMITH, JAY V., Htg. & Combus. Engr., Western Furnaces Inc. PROPOSERS: B. W. Farnes, E. H. Langdon. SECONDERS: D. C. Griffin, C. W. Finn.

SMITH, OSCAR L., Sales Engr., McDowell Heating & Cooling Corp. PROPOSERS: J. T. Lynch, G. B. Rodenheiser. SECONDERS: H. C. Sharp, James Barry, Jr.

STAFFORD, THOMAS D., Vice-Pres. & Gen. Mgr., Alexander-Stafford Corp. (*Advancement*) PROPOSERS: C. H. Pesterfield, L. G. Miller. SECONDERS: W. G. Boales, S. H. Downs.

STANEK, EDWARD W., Estimator & Designer, E. J. Stanek. PROPOSERS: R. T. Dalton, J. F. Platz. SECONDERS: W. R. Moore, F. E. Snowberg*.

STENN, SHERWIN, Student, University of Illinois. PROPOSERS: S. Konzo, N. A. Buckley. SECONDERS: J. R. Fellows, E. F. Hebrank*.

STEVENS, HAROLD C., Vice-Pres., Hunter Clark Ventilating System Co. PROPOSERS: C. W. Johnson, C. W. DeLand. SECONDERS: D. B. Scheidecker, M. J. Bamond.

STEVENS, TIBOR R., Htg. Engr., Sarcotherm Controls, Inc. PROPOSERS: M. C. Giannini, T. N. Adlam. SECONDERS: Louis Barfus, E. J. Ritchie.

SWART, ROBERT H., Vice-Pres. & Treas., Michigan Automatic Heating Equipment Co. PROPOSERS: J. W. Pulte, F. C. Warren. SECONDERS: K. E. Robinson, C. H. Pesterfield.

TIDMAN, ROY P., Student, Michigan College of Mining & Technology. PROPOSERS: F. E. Wittig, A. P. Young*. SECONDERS: V. O. York*, R. R. Seeber*.

TURNER, JOHN F., Asst. to Project Engr., Monsanto Chemical Co. (*Advancement*) PROPOSERS: T. M. Cunningham, Margaret Ingels. SECONDERS: W. G. Hillen, O. E. Gammill, Jr.

VANDERFORD, JAMES R., Student, Purdue University. PROPOSERS: W. T. Miller, F. W. Hutchinson. SECONDERS: C. F. Warner, C. W. Messersmith.

VAN DE WEGHE, RICHARD C., Student, Michigan College of Mining & Technology. PROPOSERS: F. E. Wittig, A. P. Young*. SECONDERS: V. O. York*, R. R. Seeber*.

WARD, C. V., Mgng. Dir., Atmospheric Control Ltd. PROPOSERS: Harry Wild, J. A. Yates*. SECONDERS: G. H. Priestley*, W. G. Atkinson*.

WARD, DAVID, Draftsman, Trane Company of Canada, Ltd. PROPOSERS: A. M. Dion, H. M. Treleaven. SECONDERS: Ralph Ramsey, S. A. Jennings.

WESNER, EUGENE L., Vent. Draftsman, United States Rubber Co. PROPOSERS: S. E. Fenstermaker, I. W. Cotton. SECONDERS: C. J. Carlson, W. F. Freije.

WILLIAMS, GLENN, In charge Refrig. Field Erection & Service, Hays Brothers, Inc. PROPOSERS: W. F. Freije, C. N. Warren. SECONDERS: T. R. Davis, W. T. Miller.

WILSON, JAMES A., Div. Mgr., United Gas Corp. PROPOSERS: A. E. Workman, C. A. McKinney. SECONDERS: B. P. Fisher, D. M. Mills.

WILSON, THOMAS B., Heat Engrg. Consultant. PROPOSERS: T. H. Gouldbourne, W. H. Rowlett*. SECONDERS: W. Pittman*, Harry Wild.

WIRTH, EDWARD D., Buyer, Plbg. & Htg. Div., Montgomery Ward & Co. PROPOSERS: A. L. Walters, R. S. Ash. SECONDERS: M. J. Bamond, C. M. Burnam, Jr.

WODAL, JOSEPH J., Mech. Engr., The Austin Co. PROPOSERS: J. F. Park, I. E. Mayne. SECONDERS: A. J. Hess, R. A. Lowe.

YARBROUGH, WILLIAM B., Mech. Engr., Sherlock, Smith & Adams, Inc. PROPOSERS: R. B. Dowdy, H. K. Walden. SECONDERS: L. J. Drum, Jr., M. G. Smith*.

Candidates Elected

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by **Art. B-III**, *Section* 8, of the By-Laws, the following list of candidates elected:

Members

GODDARD, WILLIAM F., Pres., Goddard-Hottel Corp., Washington, D. C. (*Reinstatement & Advancement*)

MANNING, ARTHUR J., Wm. A. Manning & Sons, Atlanta, Ga. (*Reinstatement*)

TOLHURST, G. C., Jamieson-Dansereau, Ltd., Montreal, Que., Canada. (*Reinstatement*)

Associate Member

HORNE, LESTER N., Director, Charrington, Gardner, Locket & Co., Ltd., London, England.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL SECTION

Headquarters: 51 Madison Ave., New York 10, N. Y. (Tel.: AShland 4-0291)

Officers

President.....BALDWIN M. WOODS
First Vice President.....G. L. TUVE
Second Vice President.....A. E. STACEY, JR.
Treasurer.....J. F. COLLINS, JR.
Secretary.....A. V. HUTCHINSON
Technical Secretary.....CARL H. FLINK

Council

B. M. WOODS, *Chairman* G. L. TUVE, *Vice Chairman*

Three Years: M. W. BISHOP, CARL F. BOESTER, LEO HUNGERFORD, R. F. TAYLOR.

Two Years: E. G. CARRIER, F. W. HUTCHINSON, R. A. SHERMAN, M. S. WUNDERLICH.

One Year: W. A. DANIELSON, ALFRED J. OFFNER, H. R. ROTH, ERNEST SZEKELY, E. N. MCDONNELL, L. P. SAUNDERS, *Ex-Officio.*

Council Committees

Executive—B. M. Woods, *Chairman;* A. E. Stacey, Jr., G. L. Tuve, J. F. Collins, Jr. *(ex-officio).*

Finance—A. E. Stacey, Jr., *Chairman;* R. A. Sherman, Ernest Szekely, J. F. Collins, Jr. *(ex-officio).*

Meetings—G. L. Tuve, *Chairman;* E. G. Carrier, Leo Hungerford.

Membership—M. W. Bishop, *Chairman;* F. W. Hutchinson, H. R. Roth.

Standards—M. S. Wunderlich, *Chairman;* C. F. Boester, W. A. Danielson.

Advisory Council

Alfred J. Offner, *Chairman;* Homer Addams, M. F. Blankin, W. H. Carrier, S. E. Dibble, S. H. Downs, W. H. Driscoll, E. O. Eastwood, W. L. Fleisher, H. P. Gant, F. E. Giesecke, E. Holt Gurney, L. A. Harding, H. M. Hart, C. V. Haynes, E. Vernon Hill, John Howatt, W. T. Jones, D. D. Kimball, G. L. Larson, S. R. Lewis, J. F. McIntire, F. B. Rowley, A. C. Willard and C.-E. A. Winslow.

Chapter Delegates Committee

CHAPTER	DELEGATE	ALTERNATE
ATLANTA	H. King McCain	L. L. Barnes
CENTRAL NEW YORK	E. K. Ormsby, Jr.	C. M. Ashley
CENTRAL OHIO	R. B. Breneman	H. R. Allonier
CINCINNATI	A. W. Edwards	H. K. Jennings
CONNECTICUT	L. A. Teasdale	A. J. Lawless
DELTA	F. G. Burns	J. S. Burke
GOLDEN GATE	C. E. Bentley	John Everetts, Jr.
ILLINOIS	O. J. Prentice	W. A. Kuechenberg
INDIANA	I.W. Cotton	Ferdinand Jehle
IOWA	E. O. Olson	C. A. Wheeler
KANSAS CITY	P. C. Leffel	R. B. Mason
MANITOBA	Einar Anderson	J. R. Stephenson
MASSACHUSETTS	C. W. Larson	P. A. Croney
MEMPHIS	N. C. Ledbetter	J. B. Lammons
MICHIGAN	F. R. Bishop	A. E. Knibb
MINNESOTA	J. E. Haines	A. B. Algren
MONTREAL	A. B. Madden	F. A. Hamlet
NEBRASKA	D. E. McCulley	H. J. Kleinkauf
NEW YORK	W. A. Sherbrooke	M. C. Giannini
NORTH CAROLINA	C. Z. Adams	K. W. Selden, Jr.
NORTH TEXAS	C. R. Gardner	H. J. Martyn
NORTHERN OHIO	John James	W. R. Moore
OKLAHOMA	W. W. Frankfurt	J. H. Spaan, Jr.
ONTARIO	D. A. Stott	E. G. Spall
OREGON	W. B. Morrison	J. D. Kroeker
PACIFIC NORTHWEST	E. H. Langdon	W. M. Wallis
PHILADELPHIA	J. O. Kirkbride	L. A. Childs
PITTSBURGH	D. W. Loucks	E. H. Riesmeyer, Jr.
ROCKY MOUNTAIN	J. J. Johnson	H. J. Woehlke
ST. LOUIS	G. W. F. Myers	B. L. Evans
SOUTH TEXAS	C. C. Quin	D. M. Mills
SOUTHERN CALIFORNIA	Art. Theobald	R. A. Lowe
SOUTHWEST TEXAS	R. W. Barnes	
UTAH	E. J. Watts	C. E. Murdock
VIRGINIA	R. C. Thomas	W. H. Webster, Jr.
WASHINGTON, D. C.	F. A. Leser	L. B. Nye, Jr.
WESTERN MICHIGAN	C. H. Pesterfield	H. R. Limbacher
WESTERN NEW YORK	G. E. Adema	E. J. Woolcock
WISCONSIN	F. J. Nunlist	J. R. Vernon

Special Committees

Admission and Advancement—E. L. Crosby, *Chairman;* E. R. Queer *(two years),* T. F. Rockwell *(three years).*

ASHVE *Code for Testing Heavy Duty Furnaces*—E. K. Campbell, *Chairman;* Bowen Campbell, R. S. Dill, F. A. Kitchen, A. P. Kratz, W. J. MaGirl, B. F. McLouth, F. L. Meyer, F. J. Nunlist, A. A. Olson, B. B. Reilly, Dr. H. J. Rose, H. A. Soper.

Chapter Relations—R. F. Taylor, *Chairman;* F. T. Ball, W. G. Boales, C. S. Koehler, J. Donald Kroeker, F. A. Leser, H. King McCain, G. W. F. Myers, D. L. Taze.

Constitution and By-Laws—W. T. Jones, *Chairman;* S. H. Downs, H. E. Sproull.

F. Paul Anderson Award—G. L. Tuve, *Chairman;* C. M. Ashley, F. E. Giesecke, F. C. McIntosh, D. W. Nelson.

Guide Publication—R. S. Dill, *Chairman;* R. L. Byers, R. P. Cook, R. C. Cross, B. H. Jennings, C. F. Kayan, W. M. Wallace, II, W. N. Witheridge, C. P. Yaglou, Cyril Tasker, *Ex-Officio.*

History Committee—John F. Collins, Jr., *Chairman;* Homer Addams, E. K. Campbell, W. H. Carrier, W. H. Driscoll, W. L. Fleisher, W. T. Jones, S. R. Lewis, F. C. McIntosh, G. D. Winans.

Nominating—Neil H. Peterson, San Francisco, Calif., *Chairman;* J. E. Haines, Minneapolis, Minn., *Secretary;* H. E. Adams, South Norwalk, Conn.; A. W. Edwards, Cincinnati, Ohio; C. Rollins Gardner, Dallas, Tex.; John James, Cleveland, Ohio; L. F. Kent, Atlanta, Ga.; A. S. Morgan, Toronto, Ont., Canada; C. H. Pesterfield, East Lansing, Mich.; Rex Vernon, Milwaukee, Wis.; E. C. Willey, Corvallis, Ore. *Alternates:* Leo Garneau, Montreal, Que., Canada, and L. T. Mart, Kansas City, Mo.

Promotion of Research—J. E. Haines, *Chairman;* A. J. Hess, J. B. Hewett, F. A. Leser, C. E. Price.

Publication—J. C. Fitts, *Chairman;* John A. Goff *(two years),* John James *(three years).*

Committee on Research

ASHVE Research Laboratory
7218 Euclid Ave., Cleveland 3, Ohio
(Tel.: EXpress 6161)

L. P. SAUNDERS, *Chairman*

T. H. URDAHL, *Vice Chairman* A. C. FIELDNER, *Ex-Officio*

CYRIL TASKER
Director of Research

Executive Committee: L. P. SAUNDERS, *Chairman;* T. H. URDAHL, *Vice Chairman;* R. M. CONNER, L. N. HUNTER, W. E. ZIEBER.

Three Years: R. C. CROSS, M. K. FAHNESTOCK, JOHN JAMES, F. J. KURTH, T. H. URDAHL.

Two Years: L. N. HUNTER, C. O. MACKEY, R. D. MADISON, L. G. MILLER, L. P. SAUNDERS.

One Year: R. M. CONNER, JOHN A. GOFF, F. W. HUTCHINSON, R. K. THULMAN, W. E. ZIEBER.

Technical Advisory Committees for 1947

Air Cleaning: R. S. Dill, *Chairman;* R. C. Cross*, O. C. Eliason, R. S. Farr, C. D. Graham, A. B. Hubbard, R. E. Hunsaker, D. L. Hunzicker, J. W. May, R. H. Mills, G. W. Penney, R. S. Poole, R. P. Warren, W. N. Witheridge, R. D. Wood.

Air Sterilization: W. F. Wells, *Chairman;* W. T. Anderson, Jr., L. J. Buttolph, C. W. Flood, Jr., Leonard Greenburg, M.D., B. H. Jennings, F. W. Hutchinson*, J. A. Reyniers, Mildred Wells, M.D., C.-E. A. Winslow.

Cooling Load: W. E. Zieber*, *Chairman;* C. M. Ashley, R. D. Blum, W. F. Friend, R. H. Heilman, H. W. Heisterkamp, R. C. Jordan, C. F. Kayan, J. N. Livermore, R. H. Lock, C. O. Mackey*, C. H. Randolph, J. P. Stewart.

Fuels: E. T. Selig, Jr., *Chairman;* P. R. Achenbach, J. F. Barkley, R. M. Conner*, W. A. Danielson, R. B. Engdahl, L. N. Hunter*, R. C. Johnson, S. Konzo, J. W. Miller, W. M. Myer, Jr., Harold J. Rose, T. H. Smoot, R. K. Thulman, E. C. Webb.

Glass: R. A. Miller, *Chairman;* A. B. Algren, J. E. Frazier, J. S. Herbert, E. H. Hobbie, L. K. Jones, C. O. Mackey*, F. Preston, W. C. Randall, Vic Sanders, H. B. Vincent, G. B. Watkins.

Insulation: E. R. Queer, *Chairman;* R. E. Backstrom, C. B. Bradley, H. E. Lewis, L. E. Pasek, H. E. Robinson, Vic Sanders, T. D. Stafford, R. K. Thulman*, T. T. Tucker, P. M. Woodworth.

Physiological Research: C.-E. A. Winslow, *Chairman;* Thomas Bedford, M.D., A. R. Behnke, M.D., A. C. Burton, E. F. DuBois, M.D., A. P. Gagge, F. W. Hutchinson*, R. W. Keeton, M.D., D. H. K. Lee, M.D., André Missenard, Charles Sheard.

Sensations of Comfort: C. P. Yaglou, *Chairman;* R. S. Arnold, A. R. Behnke, M.D., Thomas Chester, F. G. Ewens, M. K. Fahnestock*, J. D. Hardy, F. C. McIntosh, A. B. Newton, K. E. Robinson.

Sorbents: John Everetts, Jr., *Chairman;* F. C. Dehler, John A. Goff*, C. H. B. Hotchkiss, E. R. McLaughlin, J. C. Patterson, G. L. Simpson, F. J. Swaney.

Sound Control: T. A. Walters, *Chairman;* C. M. Ashley, P. H. Geiger, W. H. Hoppmann, II, G. C. Kerr, R. D. Madison, J. S. Parkinson, A. G. Sutcliffe, T. H. Troller.

*Member of Committee on Research.

Officers of Local Chapters

Atlanta: Organized, 1937. Headquarters, Atlanta, Ga. Meets, First Monday. President, H. King McCain, 615 Trust Co. of Georgia Bldg. Secretary, Leo Sudderth, Jr., 306 Bona Allen Bldg., Atlanta 3.

•

Central New York: Organized, 1944. Headquarters, Syracuse, N. Y. President, H. G. Strong, 300 S. Geddes St., Syracuse 1. Secretary, G. F. Keane, 316 Haddonfield Dr., DeWitt, N. Y.

Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. President, R. B. Breneman, 1282 Edgehill Rd., Columbus 8. Secretary, A. E. Norman, Jr., 1150 Chesapeake Ave., Columbus.

Cincinnati: Organized, 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. President, H. K. Jennings, 1639 Union Trust Bldg., Cincinnati 2. Secretary, K. B. Little, 832 Temple Bar Bldg., Cincinnati 2.

Connecticut: Organized, 1940. Headquarters, New Haven, Conn. President, S. R. Osborne, Waterbury 91. Secretary, Winfield Roeder, 405 Temple St., New Haven.

•

Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, J. S. Burke, 317 Baronne St., New Orleans 9. Secretary, R. B. Guest, 827 Dryades St., New Orleans 13.

•

Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Wednesday. President, F. W. Kolb, 398 Monadnock Bldg., San Francisco 5. Secretary, K. F. Baldwin, Jr., 419 Kentucky Ave., Berkeley 7.

•

Illinois: Organized, 1906. Headquarters, Chicago, Ill. Meets, Second Monday. President, W. A. Kuechenberg, 1714 Sheffield Ave., Chicago 14. Secretary, G. W. Bornquist, 629 W. Washington Blvd., Chicago 6.

Indiana: Organized, 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. President, I. W. Cotton, 1035 N. Pennsylvania St., Indianapolis 4. Secretary W. R. Fenstermaker, 215 E. New York St., Indianapolis.

Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, C. A. Wheeler, 1217 Grand Ave., Des Moines. Secretary, D. E. Wells, 701 42nd St., Des Moines 12.

•

Kansas City: Organized, 1917. Headquarters, Kansas City, Mo. Meets, First Monday. President, S. L. Furber, 7429 Forest Ave., Kansas City 5. Secretary, H. E. Gould, 1800 Baltimore, Kansas City 8.

•

Manitoba: Organized, 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, D. S. Swain, 1186 Downing St., Winnipeg. Secretary, A. W. Moss, 26 Ferndale Ave., Norwood, Manitoba.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, P. A. Croney, 72 Arlington St., Newton. Secretary, R. T. Kern, 51 Clafin St., Leominster.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, N. C. Ledbetter, 22 S. Cooper St., Memphis 4. Secretary, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, A. E. Knibb, 1003 Maryland Ave., Detroit 30. Secretary, L. A. Burch, 5853 Hamilton Ave., Detroit 2.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, L. C. Gross, 5324 Oaklawn Ave., Minneapolis 10. Secretary, L. J. Krause, 2753 4th Avenue S., Minneapolis 8.

Montreal: Organized, 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. President, T. H. Worthington, 405 Beaubien St. W., Montreal, Que. Secretary, S. W. Salter, 910 New Birks Bldg., Montreal.

•

Nebraska: Organized, 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. President, Verne Simmonds, 2416 Vane St., Omaha. Secretary, G. W. Colburn, 106 N. 15th St., Omaha 2.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, M. C. Giannini, New York University, New York 53. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, C. Z. Adams, 312 Piedmont Bldg., P. O. Box 1356, Greensboro. Secretary, M. F. DuChateau, 205 S. Lyndon St., Greensboro.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, C. R. Gardner, 1000 St. Louis St., Dallas 1. Secretary, G. A. Linskie, 3124 Milton St., Dallas 1.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, John James, 3170 W. 106th St., Cleveland 11. Secretary, W. M. Rowe, 1302 Swetland Bldg., Cleveland 15.

•

Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, W. W. Frankfurt, 319 Apco Tower, Oklahoma City. Secretary, J. H. Spaan, Jr., 1300 N. Klein, Oklahoma City 6.

Ontario: Organized, 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. President D. A. Stott, 195 Spadina Ave., Toronto. Secretary, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, C. W. Brissenden, Electric Bldg., Portland 5. Secretary, L. G. Williams, Box 304, Gladstone.

•

Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, E. H. Langdon, 72 Vine St., Seattle. Secretary, E. J. Rosen, 10238 18th Ave., S. W., Seattle 66.

Philadelphia: Organized, 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, E. H. Dafter, 12 S. 12th St., Philadelphia 7. Secretary, L. A. Childs, 330 Harrison Ave., Glenside, Pa.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, D. W. Loucks, 435 Sixth Ave., Pittsburgh 19. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

•

Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, J. F. Mohan, 2229 Blake St., Denver 2. Secretary, H. C. Kugeler, 2365 Ash St., Denver 7.

•

St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, J. H. Carter, 710 Kew West Ave., Webster Groves 19. Secretary, J. S. Rosebrough, Rm. 104, 457 Kingshighway, St. Louis 8.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, D. M. Mills, Gray and Crawford, Houston 3. Secretary, L. L. Ladewig, Box 1188, Houston 1.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Second Wednesday. President, R. A. Lowe, 6381 Hollywood Blvd., Los Angeles 28. Secretary, John L. Blake, 1700 S. Bedford St., Los Angeles 35.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, F. C. Benham, Jr., 702 S. Flores St., San Antonio. Secretary, L. S. Pawkett, 810 Insurance Bldg., San Antonio 5, Tex.

•

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, E. V. Gritton, 2479 S. 15th, Salt Lake City 5. Secretary, C. E. Ferguson, 838 Garfield Ave., Salt Lake City.

•

Virginia: Organized, 1946. Headquarters, Norfolk, Va. President, R. C. Thomas, 819 Westover Ave., Norfolk 7. Secretary, J. F. Reynolds, Gatling and Marble Ave., Norfolk 2.

•

Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, H. H. Hill, 438 Woodward Bldg., Washington 5. Secretary, J. G. Muirheid, 2017 New Hampshire Ave., N. W., Washington 9, D. C.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, Frank Harbin, Jr., 280 E. 6th St., Holland. Secretary, W. C. DeRoo, 500 E. 8th St., Holland.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, G. E. Adema, 39 W. Balcom St., Buffalo 9. Secretary, J. H. Bryce, 88 E. Girard Blvd., Kenmore.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, M. W. Bishop, 228 N. La Salle St. (Chicago 1, Ill.). Secretary, B. M. Kluge, 1817 S. 66th St., Milwaukee 14.

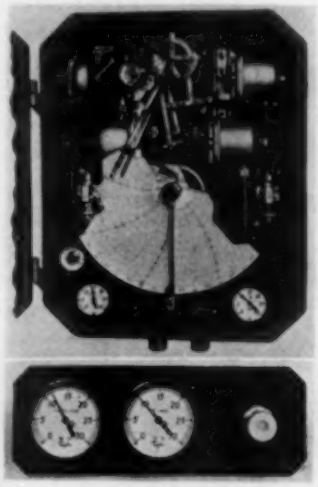
Student Branch

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, G. H. Jackson, 225 W. Nevada St., El Paso. Secretary T. V. Burns, 2307 Driscoll, Houston 6.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1947 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Transmitter-Controller Has Many Applications



No. 3479 — Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y., has developed a new "Transet" pneumatic transmission system which is, in effect, a transmitter-controller with pneumatic set control point adjustment. The unit is composed of a single duty controller for temperature, pressure, flow, liquid level, volumetric tension, or compression load together with a transmitter mechanism and a pneumatic set unit for control point adjustment. The device is said to feature precise control and to require a relatively small amount of panel space.

The small control panel utilizes a new reducing valve which is said to have unusual characteristics regarding stability, ambient temperature changes, and compensation for upstream air pressure changes. Two gages form the completed panel; one to function as the set point indicator and the other as the control point indicator. In operation, the control knob of the reducing valve is turned for any desired change which is immediately indicated on the set pointer gage. The resulting change in the controlled variable is transmitted back from the controller and is shown on the control point gage.

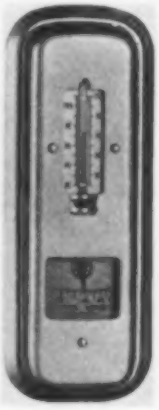
Small Arc Welder Designed for General Purpose Use

No. 3480—A general purpose "Flexarc" transformer arc welder, designed for use on single phase power lines of limited capacity, is available from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

The welder comes complete with line breaker, power cable with plug and receptacle, insulated electrode holder, electrode lead with holder and adjustment plug, work lead with ground clamp and adjustment plug, electrodes, helmet complete with lens and cover glass, wire brush, and a welding instruction manual.

The three models, WT-13, WT-16 and WT-18, are said to bring to the owner a welder ideally suited to repair jobs. They have 20 steps of current adjustment between 20 amp and the rated maximum. They provide two striking voltages; 65 volts for small electrodes on the lower half of the range, and 50 volts for larger electrodes on the upper half of the range.

Hair Elements Used in Humidity Indicator



No.3481—Production of a new Model 182 wall type relative humidity and temperature indicator has been announced by the Friez Instrument Div., Bendix Aviation Corp., Baltimore, Md. According to the manufacturer, the unit is designed to operate without attention over long periods and is sufficiently accurate for industrial as well as domestic use. Relative humidity is read directly from 10 to 95 per cent and an accuracy of 5 per cent or better is claimed. Where operation is limited to restricted ranges, greater accuracy may be obtained.

The specially treated human hair elements are said to give smooth, quick responses to humidity changes. Air temperatures are indicated from 20 to 110 F by a red liquid-filled thermometer located in the upper half of the case.

Accuracy, moderate cost, and attractive styling are said to feature the unit which measures 2⅝x7x 1½ in. deep.

Controls Combustion by Detecting Smoke

No. 3482—A combustion supervisor of improved design and construction has been announced by Worner Electronic Devices, Rankin, Ill.

Operating on the smoke detection principle, the system consists essentially of a light source projecting a

(*Continued on page* 180)

Heating, Piping & Air Conditioning [7-47]

6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

3479 3480 3481 3482 3483 3484 3485 3486 3487 3488
3489 3490 3491 3492 3493 3494 3495 3496 3497 3498
3499 3500 3501 3502 3503 3504 3505 3506 3507 3508
3509 3510 3511
6560 6561 6562 6563 6564 6565 6566 6567 6568 6569
6570 6571 6573 6574 6575 6576 6577 6578 6579
6580 6581 6583 6584 6585 6586 6587 6588

Name..... **Title**.....
Company .....
Address .....
City..... **Zone**..... **State**.....

LONG LIFE AND FREEDOM FROM TROUBLE!

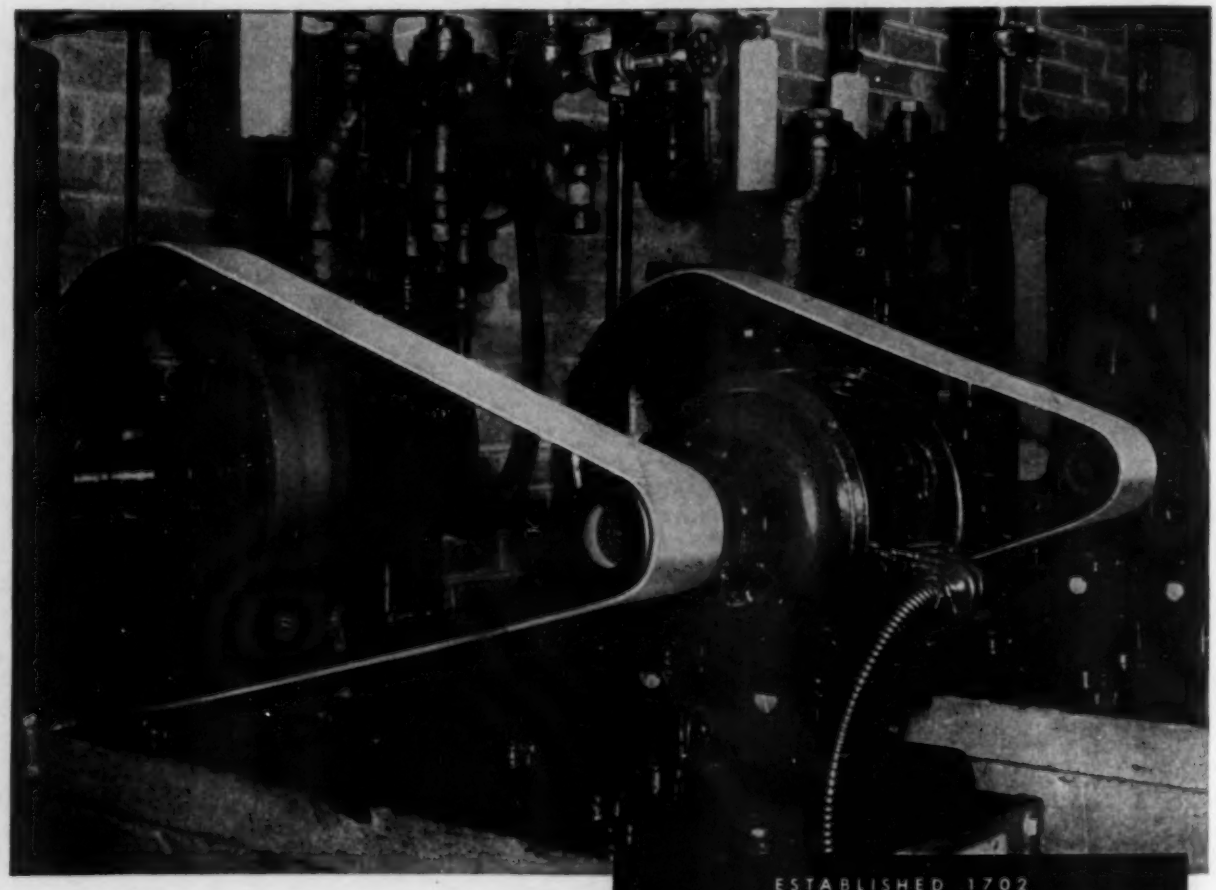
Tannate-Rockwood

TESTED RELIABILITY

Solve the drive problem once and for all! Install it, forget it! If the load varies, the weight of the motor on the pivoted Rockwood base *automatically* adjusts belt tension. Speeds are kept constant — assuring uniform flow of power, less wear on the belt and bearings.

Tannate Watershed Leather Belting has an unusual gripping surface. Tannate withstands high temperatures, water, machine oil and many chemicals; has an average strength 1/3 to 1/2 higher than most first quality oak belting. This strength, plus resistance to stretch and slippage, gives long belt life even in continuous service under unfavorable conditions.

Write us for particulars.

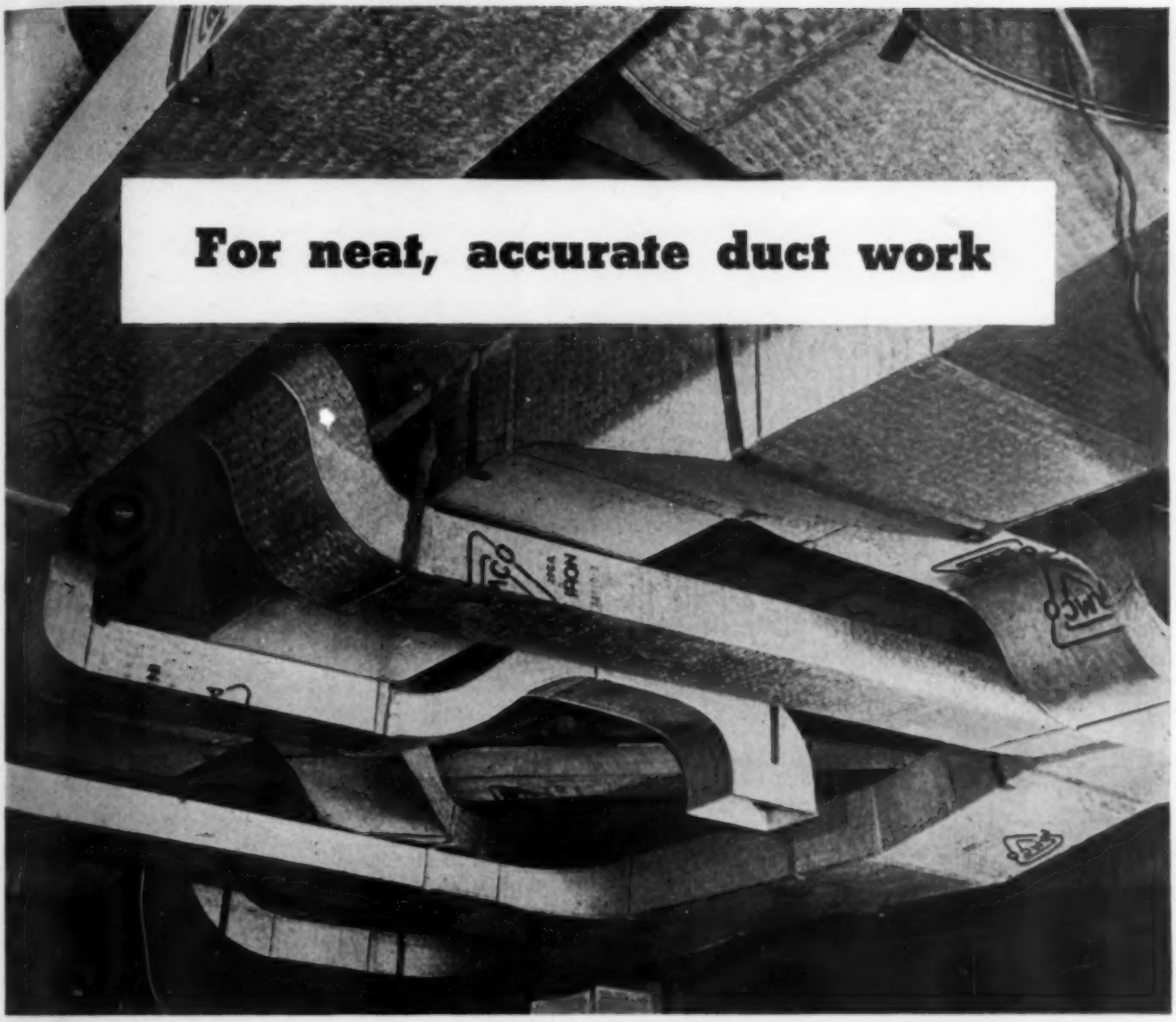


ESTABLISHED 1702

J. E. RHOADS & SONS

35 NORTH SIXTH ST., PHILA. 6, PA.

NEW YORK • CHICAGO • ATLANTA



Your sheet metal contractor can tell you how the ductility of Galvanized ARMCO Ingot Iron helps him assure you neat, accurate construction.

This special-purpose sheet is always uniform and easy to work. It takes sharp bends and double-lock seaming in its stride . . . follows faithfully the most intricate design. And Galvanized ARMCO Ingot Iron always carries a full-weight protective coating of high-grade zinc.

ARMCO Ingot Iron is the best-known trademarked galvanized sheet on the market . . . preferred for heating and air-conditioning ducts, plenum chambers, fan housings and ventilators. The famous Armco triangle is recognized as a mark of *special* quality.

Right now the demand for Galvanized ARMCO Ingot Iron exceeds the supply, but both the mill and Armco distributors are trying hard to meet your contractor's needs. The time may not be far off when you can specify it for every job you want to give lasting satisfaction. The American Rolling Mill Company, 11011 Curtis Street, Middletown, Ohio. Export: The Armco International Corporation.

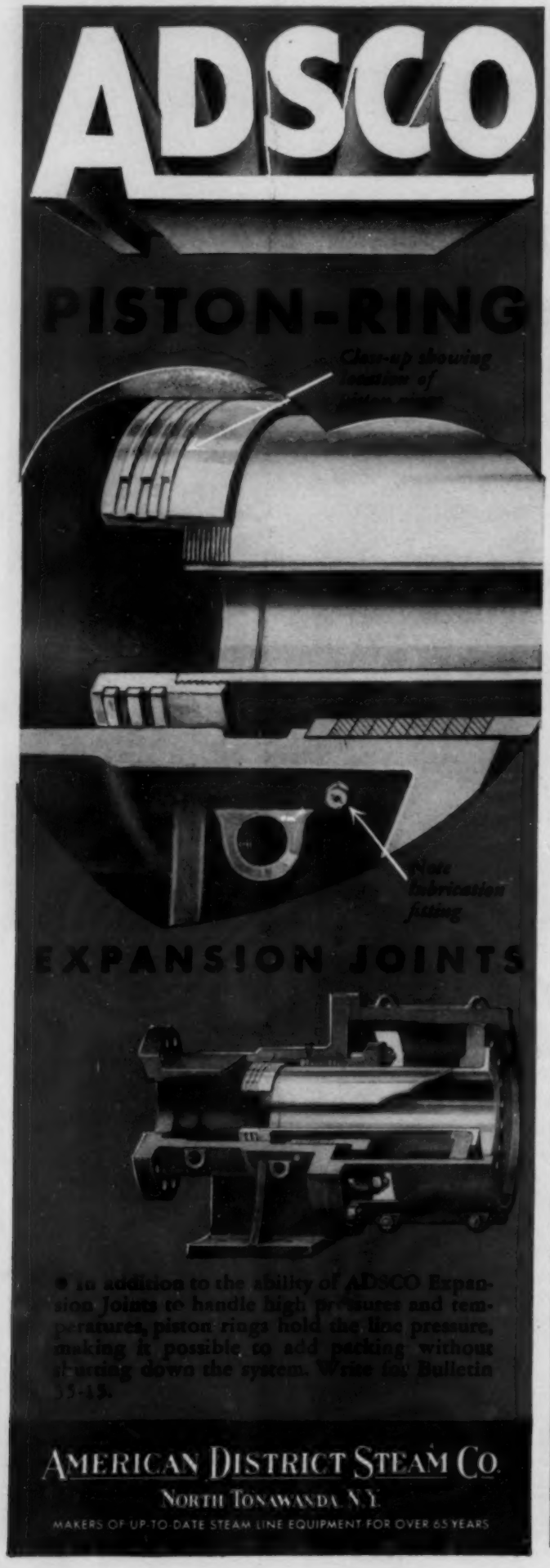
TURN IN YOUR SCRAP
Protect your steel source

Unless steel mills get more scrap at once, everybody must wait longer for steel. You can help. Check your unusable tools, machines and obsolete equipment. Collect all the iron and steel scrap you can find and speed it through regular channels to the mills. The need has never been more critical—not even in wartime.

GALVANIZED ARMCO INGOT IRON

THE AMERICAN ROLLING MILL COMPANY

- SPECIAL-PURPOSE SHEET STEELS
- STAINLESS STEEL SHEETS, STRIP, BARS AND WIRE


ADSCO
PISTON-RING
Close-up showing location of piston rings
Note lubrication fitting
EXPANSION JOINTS
* In addition to the ability of ADSCO Expansion Joints to handle high pressures and temperatures, piston rings hold the line pressure, making it possible to add packing without shutting down the system. Write for Bulletin 35-45.
AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.
MAKERS OF UP-TO-DATE STEAM LINE EQUIPMENT FOR OVER 65 YEARS

(*Continued from page* 177)

beam of light across the boiler breeching to a receiver containing a sensitive photocell. When the density of smoke passing through the breeching exceeds a predetermined level, the beam is broken and the system actuated. Smoke density is shown at all times by the meter and illuminated colored jewels on the control cabinet. Should a permanent and continuous record of boiler behavior be desired, a recording meter is available as an auxiliary accessory.

Corrosion Resistant Fittings Are Die-Formed

No. 3483*—A new line of "Nibcoloy Wrot Fittings" of inconel, nickel, monel, and stainless steels 304, 316, and 347 has been announced by Northern Indiana Brass Co., Elkhart, Ind.

Available in 11 types of tees, elbows, reducers, adapters, etc., the fittings are die-formed and are offered in sizes from ¼ to 4 in. O D. A patented lock ring assembly is designed to provide a simple and efficient method of joining with silver brazing or soft soldering (though the joints may also be butt welded). Each fitting has a permanent identification tag so that matching of metallurgical and physical properties of pipe and fittings may be accomplished at any future date.

Coiled Tubing Has Serrated Fins

No. 3484 — Coiled finned tubing of the recently developed serrated fin type is now available from Fintube Coil Corp., 19 W. Main St., Alhambra, Calif. The "Finco" tubing is made in both ferrous and nonferrous materials and in a wide range of sizes, fin heights, fin spacings, and coil diameters.**

Utilizing a new bending technique, flat or pancake coils are formed out of tubing with the serrated fins as high as ⅝ in. Substantial savings are claimed by the manufacturer in the fabrication of condensers, evaporators, unit heaters, and other types of extended surface equipment.

Motor Manufacturer Provides Styling Service

No. 3485—A styling service including product design, styling, colors, materials, and packaging is offered to users of the company's "Micromotors" by the Redmond Co., Inc., Owosso, Mich.

Retaining the services of a well known styling organization, the company is prepared to make a study of functional design as well as appearance and to submit proposed ideas, color drawings, explanatory

BUSH FLOOR-TYPE UNIT COOLERS . . . HIGH CAPACITY BOTH ABOVE AND BELOW 32° F

BUSH

OUR FORTIETH YEAR

With these high-capacity floor-type coolers, you can offer your customers a range of sizes from 11,000 to 102,000 BTU at temperatures above 32° and with a temperature differential of 10°; and from 16,500 to 153,000 BTU with a temperature differential of 15°.

Below 32°, and with a 10° temperature differential, capacities range from 8,300 to 95,400 BTU; with a 15° temperature differential, from 12,450 to 143,100 BTU.

Constructed in 3 sections for greater ease in erection, these coolers are the last word in efficient design.

Write for our new folder giving complete structural details, dimensions, and the full range of sizes and ratings. Or, obtain a copy from your nearest Bush representative.

Sold by leading refrigeration wholesalers everywhere

HEAT TRANSFER PRODUCTS • BUSH MANUFACTURING COMPANY • HARTFORD, CONN.

415 LEXINGTON AVE., NEW YORK • 549 W. WASHINGTON BOULEVARD, CHICAGO • EXPORT ADDRESS: 13 EAST 40th ST., NEW YORK • CABLE "ARLAB"

notes, etc. to the customer. All activities are handled on a confidential basis.

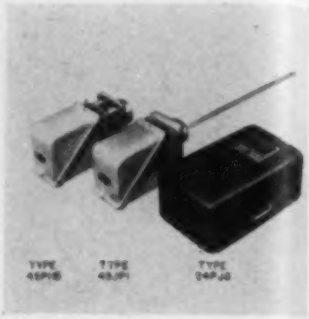
Electrical Impact Tool Has Many Uses

No. 3486 — Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y., has announced a new universal, impact tool. Using various attachments the unit is designed to apply and remove nuts; drill, ream, tap, and remove screws; drive and remove studs; extract broken studs and cap screws; run wire brushes; do hole saw work; drill brick and masonry; and drive wood augers.

Designated as Size 4U, the machine weighs only 6½ lb, has an overall length of 10½ in., a free speed of 2000 rpm, and delivers 1900 rotary impacts per minute under load. It is powered with a specially designed reversible electric motor (3 amp) that operates on 110 volt, a-c, d-c current. The unit operates as a conventional electric tool until resistance to spindle rotation reaches a certain amount. Then a patented mechanism converts the motor power into "rotary impacts" which are said to exert a more powerful turning effect than is produced by other tools.

Elimination of torque reaction to the operator by means of the impact mechanism and the fact that the motor will continue to run if the spindle becomes stalled (designed to eliminate motor burn-outs) are said to be outstanding features.

Provides Combustion Control for Oil Burners

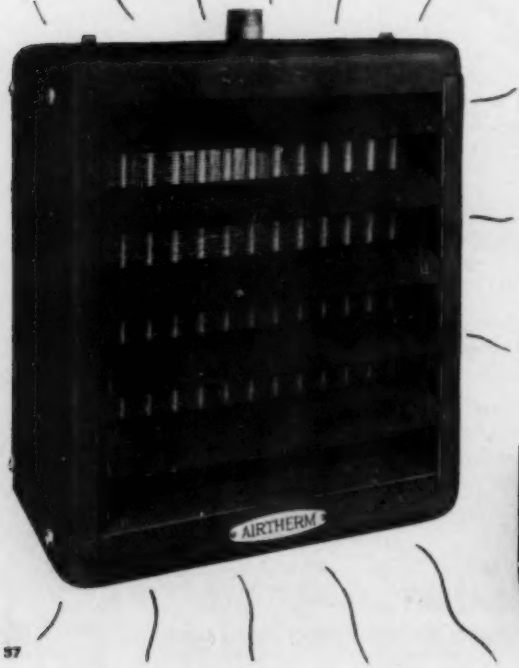


No. 3487—A new "Fireye" photoelectric flame failure safeguard for protection against the hazard of explosion in industrial oil burner installations has been developed by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass.

The equipment consists of a photoelectric scanner, Type 45PH5, for monitoring the main oil burner flame and a programming control, Type 24PJ8, for programming the oil pump, oil valve, and ignition system. Flame rod Type 45JP1 may be added to this combination if it is desired to monitor the gas pilot flame as well.

The control is designed to provide accurate setting of both oil valve delay and post ignition periods in a matter of seconds after installation. Timing is accomplished through a synchronous motor, and relay contacts are capable of handling a pump motor of 1 hp rating.

SAVE FUEL



AIRTHERM
STEAM UNIT HEATERS

PROVIDE HEAT WHERE YOU WANT IT—
WHEN YOU WANT IT

Airtherm Steam Unit Heaters can be individually controlled, providing heat only when you need it, and where you want it—thus reflecting a saving in your fuel costs. They move warm air quickly over wide areas and into remote corners, giving uniform heat throughout the plant.

There's an Airtherm Steam Unit Heater for every heating application. Write for Bulletin 1206 giving detailed information and range of available sizes.

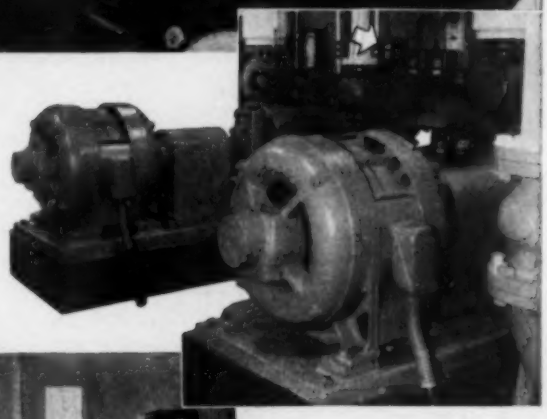
It's Wise To Buy From Your Distributor . . .
He's located near you for quick deliveries and better service.

AIRTHERM
MANUFACTURING COMPANY
711 SOUTH SPRING AVE. • ST. LOUIS, MO.

57

TESTING PILOTS
at "18,000 ft" and 50 below
in the Cornell Aeronautical Laboratory Altitude Chamber

Above—Engineers in winter flying equipment recording test data in Cornell Aeronautical Laboratory Altitude Chamber.



Right—View of the equipment room. Note Allen-Bradley motor starters in the background.

Allen-Bradley Control used throughout

Pilot reactions at high altitudes are easily determined in this modern altitude chamber at the Cornell Aeronautical Laboratory. In this chamber, the low air pressures and low temperatures encountered at high altitudes can be perfectly simulated by pulling a vacuum and by circulating refrigerated air. Motors performing these functions are operated by Allen-Bradley controls.

Allen-Bradley motor starters are so popular in refrigeration and air-conditioning installations because they are so dependable and do not require regular servicing attention. They have only one moving part—there are no pins, pivots, hinges, or bearings to cause trouble, and no flexible conductors to break. Their double break, silver alloy contacts never need maintenance, for any oxides that may form on the contacts are good electrical conductors. Then, too, their extremely simple design automatically eliminates trouble.

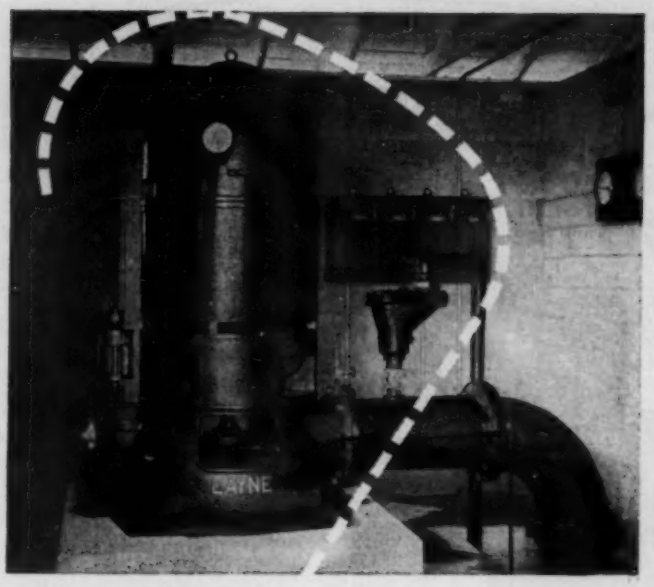
Write for information, Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.

Above—Control panel in the altitude chamber showing Allen-Bradley motor starters and relays.

Right—Bulletin 709 size 2 across-the-line solenoid starter with cover removed. The white interior reflects light in dark locations for easy installation.

A-B Quality

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY



DOWN IN
—WARRINGTON, FLORIDA

They Bought
Known Quality

Back in 1937, when the Peoples Water Service Company bought their first Layne Well Water System to serve the city of Warrington, Florida, they had only 263 connections. But Warrington, being a fine home city, grew larger and larger. By 1941 a second unit was needed, and being guided by an appreciation of known quality, none but a Layne Well Water System was to be considered. In 1945, connections had increased to 3,200, so again additional water supply was needed.

Peoples Water Service Company now have their third Layne Water System . . . one of the finest and most complete in the entire state. Powered with a 100 h.p. electric motor, turning at 1170 r.p.m., this new system is producing 1150 gallons of water per minute. The well is underreamed and packed with 20 yards of sized gravel.

Standardization on Layne Well Water producing equipment, was a very wise move. Production cost of water is exceptionally low and dependability of equipment is a major asset.

For further information on Layne Well Water developing service, address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

LAYNE PUMPS for lakes, rivers, reservoirs, irrigation, for any use where large quantities of water must be produced at low cost. Sizes range from 40 to 16,000 gallons per minute, powered by electric motor, V-belt or right angle gear drives. Write for Layne Pump Catalog.

LAYNE

WELL WATER SYSTEMS
Vertical Turbine Pumps

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. * Layne-Atlantic Co., Norfolk, Va. * Layne-Central Co., Memphis, Tenn. * Layne-Northern Co., Mishawaka, Ind. * Layne-Louisiana Co., Lake Charles, La. * Louisiana Well Co., Monroe, La. * Layne-New York Co., New York City * Layne-Northwest Co., Milwaukee, Wis. * Layne-Ohio Co., Columbus, Ohio * Layne-Pacific, Inc., Seattle, Washington * Layne-Texas Co., Houston, Texas * Layne-Western Co., Kansas City, Mo. * Layne-Western Co. of Minnesota, Minneapolis, Minnesota * International Water Supply Ltd., London, Ontario, Canada * Layne-Hispano Americana, S. A., Mexico, D. F.

Packaged Cooling Tower Completely Assembled

No. 3488—The Marley Co., Inc., Kansas City 15, Mo., is offering a new "Aquatower" packaged cooling tower for use in 3 to 15 ton refrigeration and air conditioning installations. Designed for either indoor or outdoor service, the unit is made up of standard components and is available with or without pumps.

A heavy steel integral welded case, accessibility of parts for servicing, and the use of a sturdy fan guard for safe operation are some of the features stressed by the manufacturer.

Provides Time Delay in Control Circuits

No. 3489 — Types TEC and TER time delay relays are designed to provide an adjustable or fixed time delay between the operation of a control circuit and the subsequent opening or closing of a load circuit. The manufacturer is R. W. Cramer Co., Inc., Centerbrook, Conn.

The timers are offered for automatic control of industrial processes, equipment, and machines where accurate control of the time function is necessary, such as in plastic and injection molding, heat treating, lapping and grinding and other machine operations, and induction heating. The TEC relays are equipped with an electro-magnetic clutch for automatic recycling so that a power interruption causes the repetition of the original sequence of operation. Type TER relays are equipped with a clutch which must be momentarily energized at the end of the operating cycle in order to return the timer to its normal starting position.

Needle Valve Stem Not Connected to Bonnet

No. 3490 — Reid high pressure, bar stock needle point valves are designed for operating pressures from 500 to 25,000 psi and for use on air, gas, fluid, and steam lines. They are distributed exclusively by Combined Engineering & Sales Co., 154 W. Colorado Blvd., Pasadena 1, Calif.**

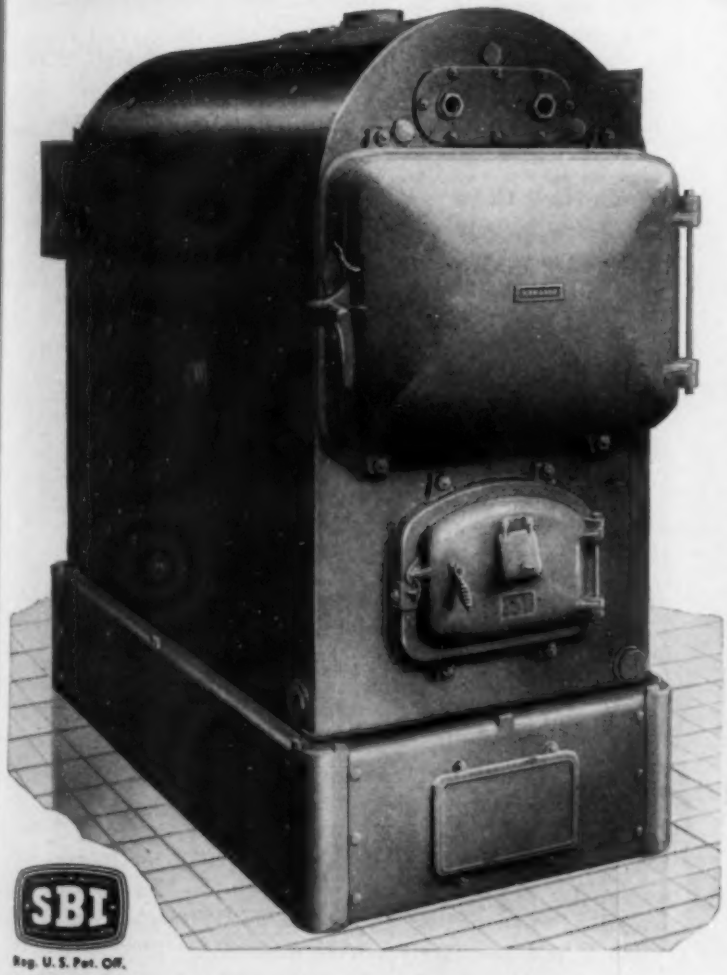
When the stem is backed up to the limit of its threads, it stops on a specially designed seat which

Another ☆ in the Kewanee Line

{ for Heating Medium Size Buildings Dependably with High Efficiency }

KEWANEE

SQUARE-HEAT TYPE R BOILER



SBI
Reg. U. S. Pat. Off.
MEMBER

● **The Kewanee Square Heat Boiler is an improved "streamline" version of previous Type R models,** *redesigned and simplified in one super-fine series.* These eight new 3R units incorporate all the features which have made the 16 sizes of Kewanee Type R so popular during the last seventeen years.

● This Square Heat Series takes in the upper bracket ratings as developed in the Steel Boiler Institute Code for residential boilers . . . making it ideally suited for *heating medium size buildings with* unusually high efficiency.

● For Oil, Gas or Coal (stoker or hand fired) and *easily and quickly converted from one fuel to another.* You can switch from oil to gas and back again, and a change to coal requires no alterations in the boiler proper.

Eight Sizes for 740 to 3000 Square Feet Steam, S.B.I. Net Rating.

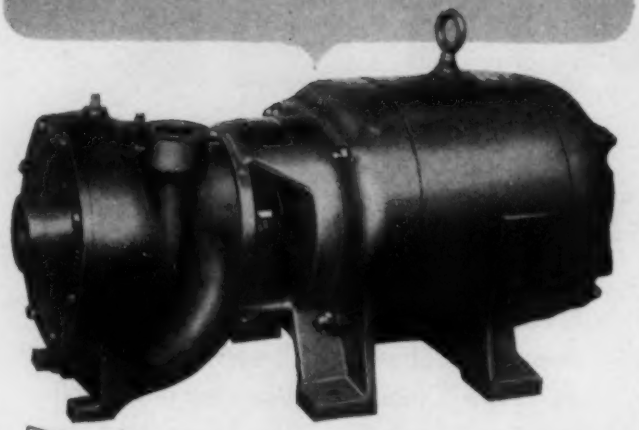
ARMY E NAVY
Won For 5th Time

KEWANEE BOILER CORPORATION
KEWANEE; ILLINOIS
Branches in 60 Cities—Eastern District Office: 40 West 40th Street, New York City 18
Division of American Radiator & Standard Sanitary Corporation

OVER 75 YEARS BOILERMAKERS

EFFICIENCY! ECONOMY! ADAPTABILITY!

for DEPENDABLE CIRCULATION of BRINE AND CHILLED WATER!



Type GG Two Stage Unipump with 15 H.P. motor.

OPERATES EFFICIENTLY IN ANY POSITION

WEINMAN Centrifugal UNIPUMPS

CAPACITIES 10 TO 1000 G.P.M.

UNIPUMPS are engineered by WEINMAN CENTRIFUGAL SPECIALISTS to meet the need for a highly efficient, quiet and leakless BRINE AND CHILLED WATER CIRCULATOR . . . at a reasonable price!

They will operate efficiently regardless of the angle of installation on floor or wall . . . require minimum space . . . and are easy to install.

Built in sizes to provide capacities of 10 GPM to 1000 GPM . . . heads to 500 feet . . . and motor ratings from ½ hp to 30 hp.

WEINMAN CENTRIFUGAL SPECIALISTS are at your service . . . To Give Service . . . got a problem? . . . phone, wire or write.

Bulletin 726-C2 sent upon request.

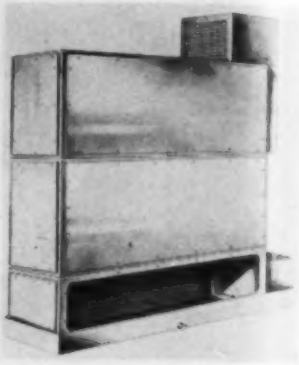
CENTRIFUGAL SPECIALISTS

WEINMAN PUMP MFG. Company

COLUMBUS · 8 · OHIO

is said to be blowproof and screwproof. The stem has no direct connection with the bonnet which is held in place by a union type bonnet nut. Available in standard sizes from ¼ to 1 in., the valves have stainless steel trim and may be repaired or regrooved without disturbing the packing.

Evaporative Condensers Feature Scale Prevention



No. 3491—Worthington Pump and Machinery Corp., Harrison, N. J., has announced the new ECZ "Freon" and ammonia evaporative condensers and the WCZ evaporative water coolers. Flexibility of installation, ease of operation and service, and the incorporation of new techniques for preventing corrosion and scale formation are said to be outstanding features.

The condensers are built in five standard sizes with nominal capacities ranging from 10 to 50 tons for "Freon-12" service and 5 to 50 tons for ammonia service.

Finds New Uses for Time Switch

No. 3492—A new range of applications for the "Comfortrol," a compact time switch for automatically turning electrical fixtures and appliances on and off at given times, has been announced by Holcomb & Hoke Mfg. Co., Inc., Indianapolis 7, Ind.

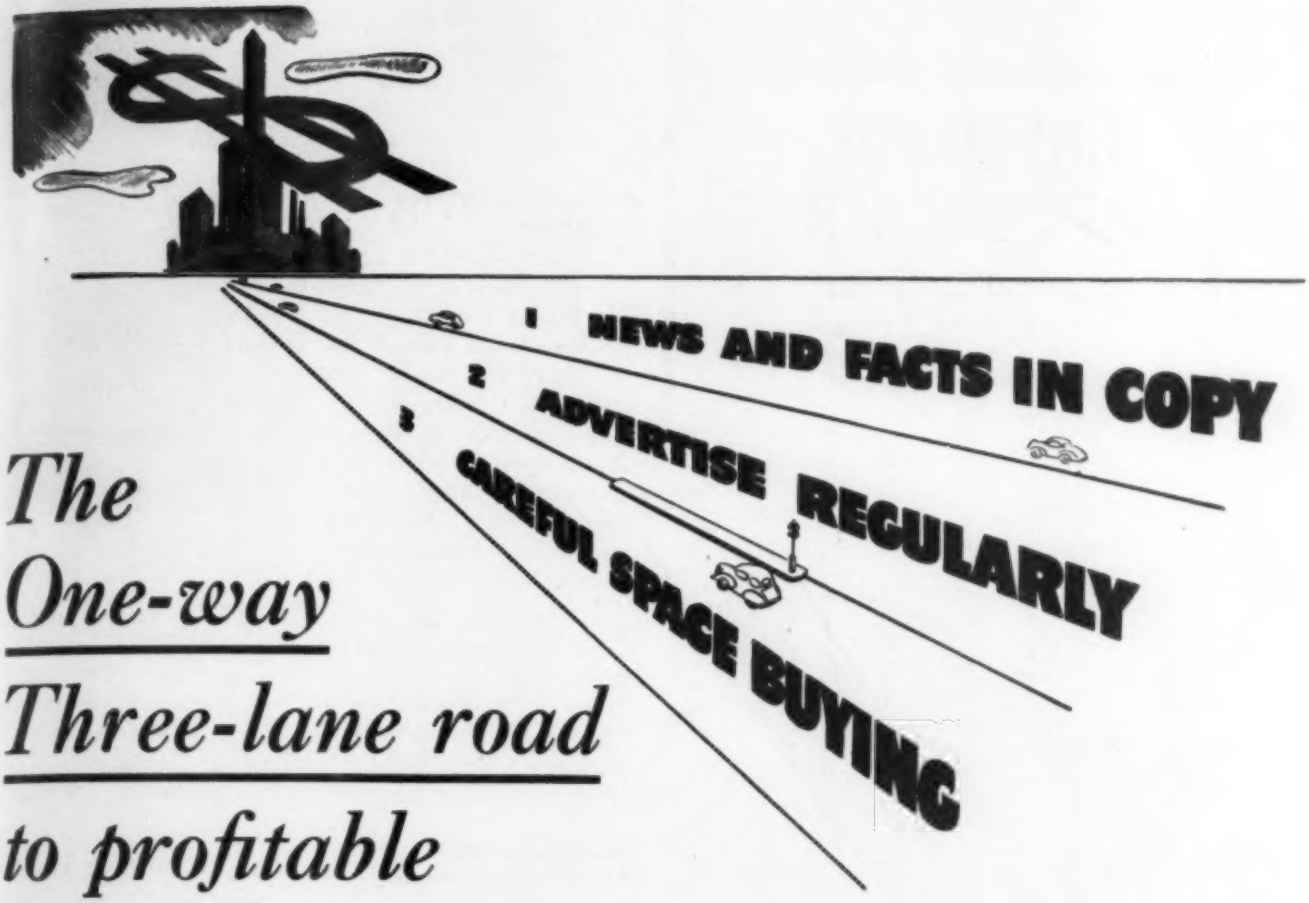
Originally developed for the automatic control of the company's "Silent Breeze" ventilating fans, the unit is adaptable to turning on and off lights and many electrical appliances.

The time switch is designed to operate on a 24 hour cycle and can be set for either repeating or nonrepeating operation. Finished in chromium and stainless steel, it is compact enough to fit over any standard wall outlet box.

Power required is 115 volt, 60 cycle. A ¾ hp repulsion-induction, condensor or capacitator motor, or a ¼ hp split-phase motor constitutes its maximum load. It will handle up to 750 watt standard or neon lamps and 1000 watt heater elements. The switch is a single pole, single throw type and the motor is self-starting and synchronous.

Stainless Steel Electrode Designed for Low Temperatures

No. 3493—A new line of stainless steel electrodes for both a-c and d-c arc welding called "LowTemp EutecTrodes," has been developed by Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y.



The One-way Three-lane road to profitable Business Paper Advertising

Successful business paper advertising calls for the application of these three basic principles:

1 Make your advertising copy clear, concise, complete and informative. People read business papers to get business information. Give them facts and news about your products and services.

2 Advertise regularly. Do what your successful salesmen do—call on customers and prospects consistently.

3 Buy space carefully. Select media only on the basis of audited values and thus protect your advertising investment. Guesswork is wasteful and expensive.*

*Reports issued by the Audit Bureau of Circulations tell you how much circulation a publication has; where it goes; how it's obtained; an occupational or industrial analysis of subscribers; and what the subscribers paid for it.

A.B.C. reports give you verified facts as to quantity and methods—an essential index to quality of circulation.

A. B. C. PROTECTS YOUR ADVERTISING

Paid subscriptions, renewals, evidence of reader interest, are among many facts in A. B. C. reports that are definite guides to effective media selection. When you buy space in A. B. C. publications your advertising is safeguarded by audited circulation. Always ask for A. B. C. reports.

Heating Piping & Air Conditioning

This publication is a member of the Audit Bureau of Circulations. For verified information about the audience that you reach when you advertise in these pages, ask for a copy of our latest A.B.C. report.

A. B. C. = AUDIT BUREAU OF CIRCULATIONS = FACTS AS A MEASURE OF CIRCULATION VALUES

THIS HANDY PIPE WRENCH *Cuts Tool Costs*

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO.
ELYRIA, O.
TRADE RIDGID MAR

RIDGID Guarantee means no housing repairs or expense at all—ever

End wrench for pipe in coils or on flat surfaces.

● *For your worker*—comfort grip I-beam handle he can throw his weight around with; adjustment nut that spins easily in all sizes, 6" to 60"; pipe scale on hookjaw that fits it to pipe without time waste. *For your business*—guarantee against warp or break of housing, no replacement expense and bother, fewer spares needed, *plus* profit from fast, easy work. Follow the lead of enthusiastic users of millions of RIDGID tools—ask your Supply House for these efficient pipe wrenches.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

According to the manufacturer, these flux-coated electrodes make possible stainless steel welding at low base metal temperatures which minimizes the effect of welding heat on the corrosion resistance and the physical properties of the base metal.

Small Motor Drives Rheostats

No. 3494—Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y., has developed a small motor drive for remote and automatic operation of single or multiple stamped steel rheostats controlling generator voltages, motor speeds, lamp intensities, and other rheostat applications.

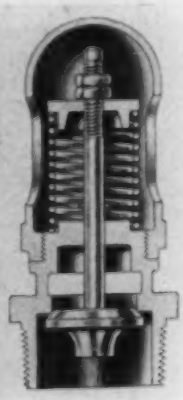
Available for a-c and d-c, 115 or 230 volt operation, units have 30 or 60 sec travel from the "all resistance in" to the "all resistance out" position. The motor drive is constructed on a 13 in. diameter steel plate and is intended for mounting on extended feet. Special features, which may be obtained on special order, include high speed return and presettable limit switches.

Humidifier Uses Low Pressure Steam

No. 3495—Techtmann Industries, 714 W. Wisconsin Ave., Milwaukee 1, Wis., national distributors, has announced the development of the "Humid-O-Matic" steam humidifier manufactured by the Skilbeck Mfg. Co.

The unit is said to diffuse up to 20 gal of water in 24 hr with 5 psi steam pressure while a larger model diffuses up to 100 gal per 24 hr. All models are designed to operate on steam pressures from 1 to 10 psi. Air is prevented from entering the system when steam pressure drops below atmospheric pressure and the unit is designed to shut off if condensate is not removed fast enough to prevent overflowing. Surplus condensate is returned to the supply line against higher pressure.

Vacuum Breaker Made Tamperproof



No. 3496 — Associated Valve and Engineering Co., 1150 W. Marquette Rd., Chicago 21, Ill., is the national distributor of the new No. 1724 vacuum breaker developed by the Schade Valve Mfg. Co. of Philadelphia. The device is designed to protect jacketed kettles, closed tanks, hot water generator coils, heating units, etc.

When inside pressure becomes subatmospheric beyond a predetermined point, air is admitted into the

unit which is a single-seated valve of all bronze construction utilizing a stainless steel spring. A housing is used to enclose the spring and to prevent alteration of the setting through tampering or accidental bumps. Available sizes range from ½ to 2 in.

Ventilation Fan Package Includes Suction Chamber

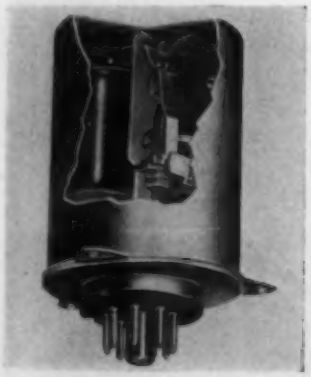
No. 3497—With the development of a new, prefabricated suction chamber for use with "Silent Breeze" ventilating fans, the Holcomb & Hoke Mfg. Co., Inc., 1545 Van Buren, Indianapolis 7, Ind., now offers a "package" of automatic ventilation for home, business, and industry.

This package includes the fan itself, built in a variety of sizes for all types of home, commercial and industrial applications; the suction chamber; the "Comfortrol," a time switch operating on a 24 hr cycle, for automatic fan operation; and two kinds of automatic shutters, one for ceiling and another for sidewall installation. These shutters, both of flush type design, open as the fan comes on and close as it is shut off.

The suction chamber, shown here with the fan in assembled position, is designed to provide a leakproof enclosure between the fan and the automatic ceiling shutter or grille. Constructed with a metal-reinforced wood frame, it has self-sealing joints and panels of sound absorbing material.

Chamber and fan, when installed, rest on vibration damping material.

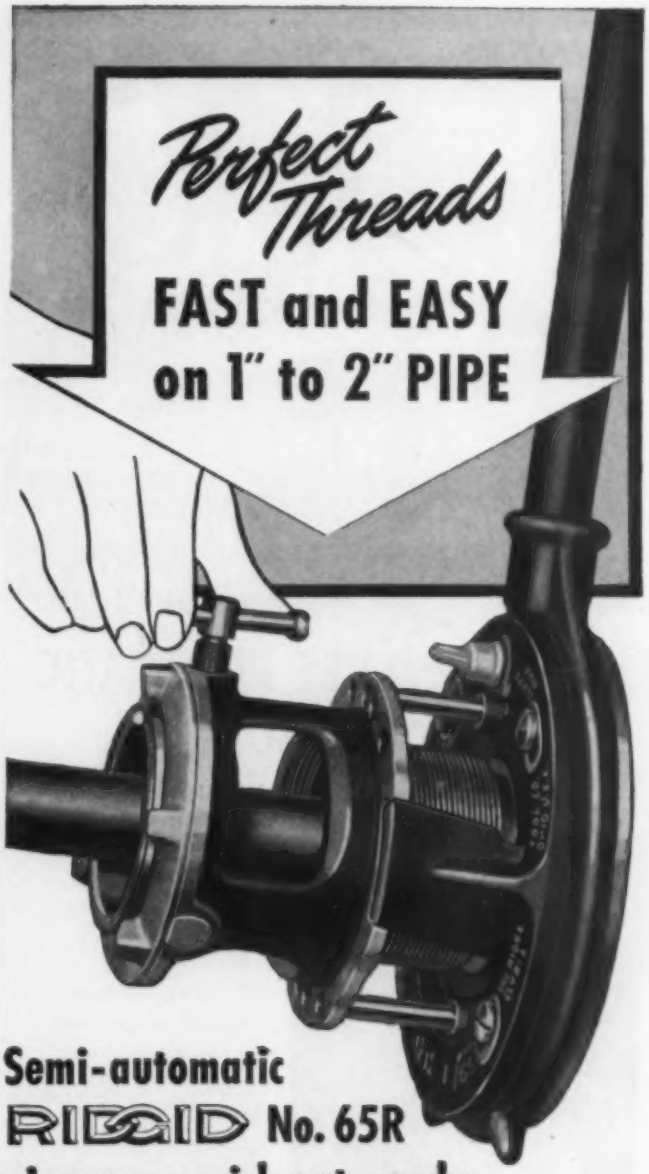
Plug-In Type Relay Hermetically Sealed



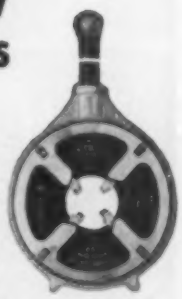
No. 3498 — Ward Leonard Electric Co., 37 South St., Mount Vernon, N. Y., has announced the development of the new Bulletin 108 sensitive relay which is of the plug-in type mounted on a standard octal plug base and enclosed in a cylindrical metal can hermetically sealed against moisture, gases, dust and other detrimental atmospheric conditions.

The relay is provided with a normally open single pole contact having contact ratings of 2 amp, 24 volts a-c or d-c, 0.75 amp, 125 volts d-c, and 2 amp, 125 volts a-c (a-c ratings are for noninductive loads at commercial frequencies). With a low average coil consumption of 0.056 watts the units are said to be suitable for current sensitive applications from 1.3 milli-amp to 0.54 amp on direct current and are applicable for operation on nominal d-c voltages from 0.1 to 48.

Outstanding features, says the manufacturer, in-



Semi-automatic
RIDGID No. 65R
gives you quick get-ready
... quick accurate threads



Stands up on floor, ready at hand.

● No wonder this remarkable threader has won friends everywhere. It's self-contained — threads 4 sizes of pipe with one set of high-speed steel chasers that stay in it, no extra dies to lug around or lose. It's semi-automatic — sets to pipe size in 10 seconds; workholder sets instantly, only one screw to tighten, no bushings to fuss with. Cuts perfect threads with least effort, saves time and work. Buy No. 65R at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY · ELYRIA, OHIO

DEPENDABLE AUTOMATIC ACCESSORIES...

Here's a ready source of extra sales and profits — all the folks in your community who own Vaporizing Burner Oil Heaters! Show them how these A-P AUTOMATIC ACCESSORIES will pay for themselves in oil savings, greater convenience, steadier heating.

Thermostatic Heat Regulator Set Model 240-ED

Adds THERMOSTATIC Temperature Control convenience and economy to any heater using A-P Model 240-DR, UR, or YR Oil Controls—made since 1939. Easily installed set includes Electric Conversion Top, Thermostat, Transformer and accessories.

OILIFTER — for Automatic Fuel Handling

Avoiding fuel handling and messy "Bucketing" of fuel oil in the home. The A-P OILIFTER, draws oil from remote bulk storage tank as far away as 100 feet or three stories. It can be mounted on ANY FUEL OIL BURNING APPLIANCE. It's a great convenience in any oil-heated home.

Write for details, prices and sales helps on these fast-turnover A-P AUTOMATIC ACCESSORIES

BE SURE your new heater lines use A-P DEPENDABLE OIL CONTROLS — for faster sales, greater customer satisfaction.

AUTOMATIC PRODUCTS COMPANY

2460 NORTH THIRTY-SECOND STREET, MILWAUKEE 10, WISCONSIN

DEPENDABLE *Oil Controls*

DESIGNED TO ELIMINATE SERVICING

clude highly accurate sensitivity, low power consumption, compactness, no exposed wiring, and protection against all adverse atmospheric conditions.

Plant Expansion Makes Possible New Pulleys

No. 3499—The recently completed plant expansion program of the Congress Die Casting Div., Congress Tool & Die Co., 3750 E. Outer Dr., Detroit 12, Mich., has made possible the production of 11 in. and 16 in. pulleys. These new sizes give the company a complete line from 1½ to 16 in. diameters.

According to a recent announcement, large stocks of the company's products, which include step cone pulleys, variable speed pulleys, and flexible couplings, are carried to insure prompt delivery.

New Tripping Action in Circuit Breaker

No. 3500—The new "Quicklag" circuit breakers are designed to provide a new tripping action which combines the inverse time limit characteristics of bimetal thermal action on overloads with the operating speed of magnetic trip action on short circuits. The manufacturer is Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

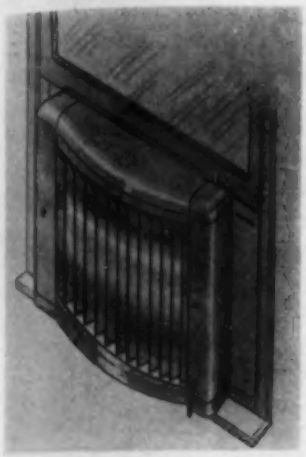
Available in single or double pole, 10 to 50 amp, 125 to 125/250 volts a-c, the breaker is said to provide a redesigned "De-ion" arc chute that eliminates the need for a vent screen in the bottom, thereby permitting mounting flush to pan. This eliminates the need for the ⅜ in. mounting clearance formerly required. Other improvements claimed include: a sturdier operating handle more enclosed than the old, internal design which requires less handle movement, a hole in the handle to permit a more satisfactory method of attaching handle extension for two pole operation, and a smooth flush surface to eliminate dust traps.

Alloy Bearings in Draft Regulator

No. 3501*—A new "Sentry" draft regulator, constructed with bearings of noncorrosive metal, has been announced by the Krueger Sentry Gauge Co., 1056 W. Mason St., Green Bay, Wis.

Finished in two colors, it is said to be responsive to the slightest breeze, to be trouble free, inexpensive, and to be of sturdy construction.

Evaporative Cooler Fits in Window



No. 3502 — The Palmer Mfg. Corp., Phoenix, Ariz., makers of the "Sno-Breze" evaporative cooler, has announced production of a new model window type cooler designed to fit any window from 24 to 34½ in. width. Adjustable, directional air louvers, together with the motor and water switches, are located on the front of the unit so as to provide control of operation from within the room.

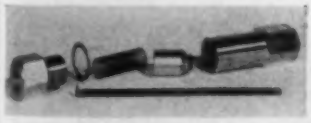
Features are said to include the use of a 22 gage steel cabinet, a recessed fan orifice for preventing air loss or recirculation, and a "Sno-Fluf" cooling pad of pure, odorless aspen. The 16 in. fan is driven by a 1/25 hp motor.

Soot Destroyer Now in Liquid Form

No. 3503—"Chimney Sweep" soot destroyer, which has been on the market for several years in powder form, is now available in liquid form for use with all makes of oil burners and with all grades of fuel oil or kerosene. The manufacturer is G. N. Coughlan Co., West Orange, N. J.**

In addition to helping remove soot in furnaces, flues, and chimneys, and aiding in preventing soot from forming, it is claimed that this liquid also conditions the fuel oil by helping to dissolve and remove gum, sludge, and water. It is also said that the material is not harmful to metals or refractory brickwork.

Double Seal Used in Check Valve



No. 3504—A new check valve, developed by Mansfield & Green, 1071 Power Ave., Cleveland 14, Ohio, has a double seal.

A metal to metal seat plus a resilient rubber or synthetic rubber ring seal on the check valve poppet are used. The line pressure forces the resilient ring to the metal seat and thus provides greater sealing force at higher pressures. It is claimed that at 10,000 psi pressure the valve shows no leakage even with grit 0.01 in. diameter in the system.

Available sizes range from ⅛ to 1 in. SPT, for pressures up to 10,000 psi, and for any media not destructive to rubber or synthetic rubber.

Regulates Air Pressure for Air Operated Tools, Machines

No. 3505—A. Schrader's Son, Div. of Scoville Mfg. Co., Inc., Brooklyn 17, N. Y., has announced the introduction of a new air regulator.**

PREVENT

Rust·Scale·Dirt

FROM CLOGGING STEAM EQUIPMENT

YARWAY STRAINERS

"The Screen's the Thing"

- *A High Grade Monel Woven Wire Basket* with mesh fine enough to catch the dirt—yet ample free area for passage of clean condensate, oil and other fluids.
- *Body Cadmium Plated for Protection Against Corrosion and for better appearance.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by nearly 150 Mill Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 Lbs.*

See Your Supply House or write for Bulletin S-201

YARNALL-WARING COMPANY

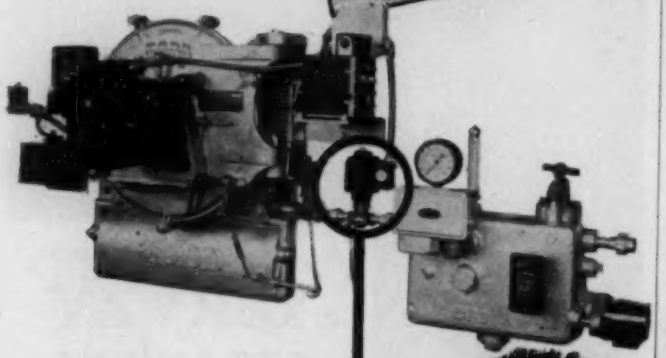
107 MERMAID AVENUE·PHILADELPHIA 18, PA.

YARWAY STRAINERS

ASCO

ELECTRICALLY OPERATED SOLENOID VALVES

24 hour CONTROL AS WELL AS PROTECTION FOR THIS OIL BURNER



Note the valve on this oil burner installation. It's an ASCO Solenoid Valve located in the fuel line between supply and burner to fill a dual role:

1 . . . it automatically controls flow of oil to burner as required by thermostat or similar device, being manually adjustable to regulate amount of oil flowing.

2 . . . it functions as an emergency shut-off valve, closing instantly should any one of a number of things go wrong. It can change from full flow to fully closed "in nothing flat."

Would such a solenoid valve as this take care of your oil burner shut-off and control problem? If not, perhaps one of our many other types will serve you. We have a complete line of standard Shut-off Valves from which to make recommendations. Or, if no standard valve fits the case, we are in position to design and make a special valve.

Bear in mind, too, that we have a complete line of Solenoid Operated Valves—Safety Shut-off and Trip; Shut-Off; Pilot Operated 2, 3 and 4 Way Valves; Explosion Proof Valves—to take care of any other automatic control problem you may have.

We also manufacture a quality line of Automatic Transfer Switches, Remote Control Switches, Contactors and Relays.

ASCO Solenoid VALVES

Automatic Switch Co.

49-C EAST 11th STREET, NEW YORK 3, N. Y.

The new unit is adjustable to function in systems operating at pressures from 10 to 150 psi and is designed to deliver air to any working part used in conjunction with air cylinders, machine controls, etc. at the pressure for which the regulator is set (always less than lowest line pressure), saving wear and tear on the compressor and reducing air costs. Another purpose of the regulator is to keep the pressure at the equipment constant regardless of any wide variation in the system pressure.

Improved Soldering Flux Molded in Stick Form

No. 3506*—"Flux-Stik" is a specially designed soldering flux molded into stick form and is designed for application on either hot or cold metal. The manufacturer is Lake Chemical Co., 607 Western Ave., Chicago 12, Ill.

According to the manufacturer, the solder is nonacid yet it thoroughly and quickly dissolves the oxides of metals and thus prepares a clean surface for the solder. It is nonrunning when heat is applied and will not spread all over the surface of the metal. It is said to be ideal for use in overhead or difficult soldering locations and can be used for sweat joints of copper or brass tubing, manifolds, traps, piping, sheet metal, refrigeration and heating coils, etc.

Lime, Lime-Titania Coatings on Stainless Steel Electrodes

No. 3507—A complete line of "Airco" stainless steel electrodes in a full range of grades and diameters has been announced by Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.

Electrodes are furnished with a heavy extruded lime type coating for d-c application. In addition all but the straight chrome analyses are obtainable with a lime-titania type coating which is usable on a-c or d-c. The slag produced by either of these coatings is said to be easily removed.

Develops, Prints Positive Copies

No. 3508 — The new "Streamliner" reproducing machine, developed by the Ozalid Div., General Aniline and Film Corp., Johnson City, N. Y., is designed to reproduce as a positive copy anything drawn, typed, printed, or photographed on translucent material. Prints are delivered completely dry.

The unit is said to be especially suitable for use in schools, colleges, business offices, and drafting rooms. Only 25 sec are required to reproduce standard sized engineering drawings, accounting reports, file cards, photographic film positives, and other translucent positives.

Lines and images can be reproduced in black, blue, red, sepia, or yellow on either paper, cloth, foil, film, or plastic. In addition, five color transparent film overlays or copies of "Ansco" or "Kodachrome" transparencies may be made. The unit will handle material of any length up to 42 in. width and the printing speed may be adjusted up to 10 ft per min.

Alloy Portable Hand Shears Have Removable Cutting Blades

No. 3509—Featuring all-alloy construction throughout, the new portable hand shears offered by the Bremil Mfg. Co., 1204 Pittsburgh Ave., Erie, Pa., have removable cutting blades of special heat treated and ground alloy, shear blade steel.

Two sizes are offered. The No. 1 shear, weighing 22 lb, is designed cut up to No. 11 gage without springing the jaws. The No. 2 mill type shear, weighing 28 lb, is said to operate safely and continuously without overstressing any of the parts and to cut ¼ in. thick, 0.40 carbon stock.

For maximum cutting results of stainless steel, especially treated blades are available.

Adjustable Work Stands Hydraulically Operated

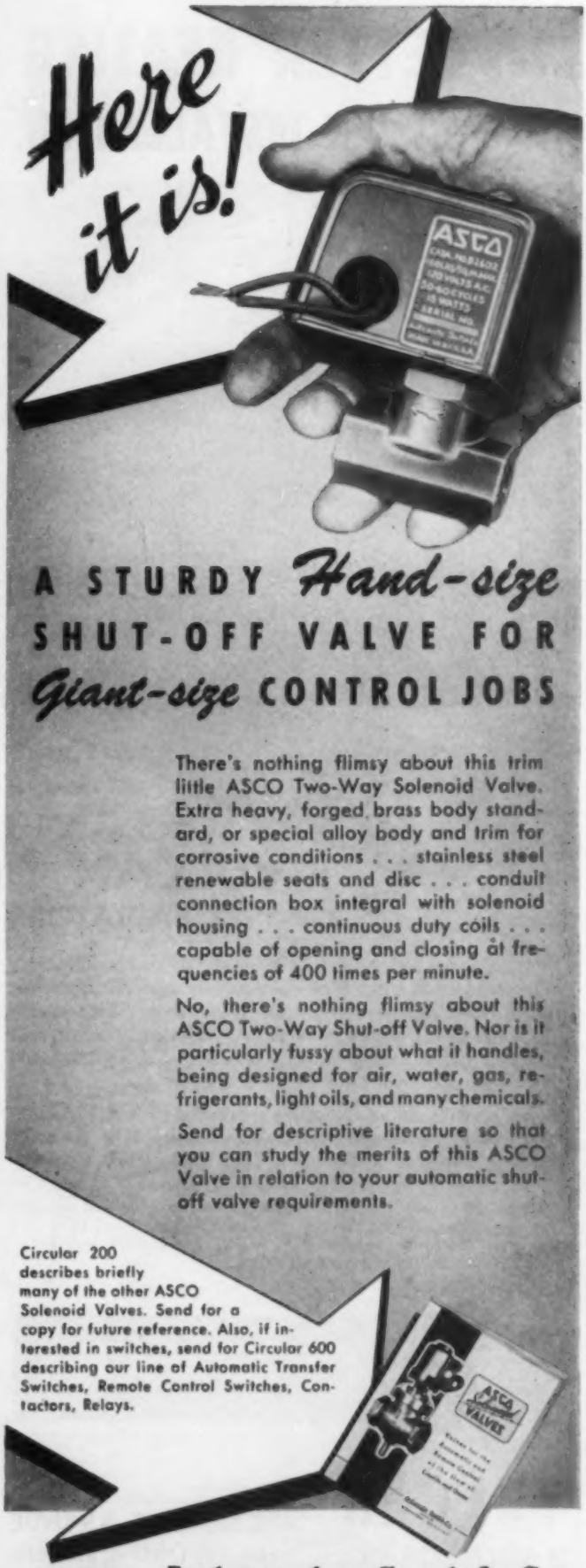
No. 3510—"Aerostands," hydraulically operated adjustable work stands, which were developed for wartime aviation applications, are now available for general industrial use, according to the manufacturer, Airquipment Co., Dept. GU, Burbank, Calif.

A 16 sq ft work platform, with a maximum static load capacity of 1500 lb, is hydraulically elevated or lowered to any desired working level from 3 to 24 ft. Self-adjusting steps maintain their position parallel to the ground regardless of the angle of elevation. All models are equipped with guard rails and skidproof surfaces on platforms and steps. Frames are constructed of welded tubular steel mounted on swivel casters with caster locks.

Control Manufacturer Expands Line in New Plant

No. 3511—Synchro-Start Products, Inc., 221 E. Cullerton St., Chicago 16, Ill., manufacturer of automatic starting, stopping, and protecting systems, overspeed governors, solenoids, automatic cranking units, motor contactors, relays, and multiple engine panel boards, is now in full production in its new plant.

War production experience and an enlarged engineering staff are said to be responsible for the development of various new electronic controls. Other new applications include automatic engine-driven fire pumps and multiple engine-driven generator installations where the engines are controlled automatically in accordance with the load.


Here it is!
ASCO
A STURDY Hand-size SHUT-OFF VALVE FOR Giant-size CONTROL JOBS
There's nothing flimsy about this trim little ASCO Two-Way Solenoid Valve. Extra heavy, forged brass body standard, or special alloy body and trim for corrosive conditions . . . stainless steel renewable seats and disc . . . conduit connection box integral with solenoid housing . . . continuous duty coils . . . capable of opening and closing at frequencies of 400 times per minute.
No, there's nothing flimsy about this ASCO Two-Way Shut-off Valve. Nor is it particularly fussy about what it handles, being designed for air, water, gas, refrigerants, light oils, and many chemicals.
Send for descriptive literature so that you can study the merits of this ASCO Valve in relation to your automatic shut-off valve requirements.
Circular 200 describes briefly many of the other ASCO Solenoid Valves. Send for a copy for future reference. Also, if interested in switches, send for Circular 600 describing our line of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays.
ASCO Solenoid VALVES
Automatic Switch Co.
49-C EAST 11th STREET
NEW YORK 3, N. Y.

FOR **BETTER HEATING**
AND **EASIER INSTALLATION**

VULCAN
FIN-TYPE RADIATORS

Imagine the difficult and cumbersome job that would be encountered installing heavy pipe or cast iron radiators in place of the VULCAN fin-type installation shown above. In this case VULCAN radiation was installed easily and effectively in that heat distribution was provided where it was needed and cold down drafts were eliminated.

This is only one of the many applications where VULCAN serves to maintain even temperature control. In hospitals, churches, theatres, auditoriums, schools, ships and industrial plants all over the country VULCAN is proving through its wide range of use and application to be the accepted modern radiator.

Representatives in principal cities.

Where desired grille covers can be furnished for VULCAN radiation.

VULCAN
RADIATOR CO.

26 FRANCIS AVENUE
HARTFORD 6, CONN.

RADIATOR MFGS. FOR OVER TWO DECADES

Equipment Shorts

All the listed quotations on the large electric motors, generators, and control equipment offered by Electric Machinery Mfg. Co. of Minneapolis are now being made on a firm basis.

The Baker Ice Machine Co., Inc. has announced the opening of a new factory at South Windham, Maine (near Portland). According to the company, both ammonia and "Freon" compressors and condensing units ranging in size from 1½-15 hp will be produced at the new plant to which all general correspondence and orders for equipment regardless of size (except renewal parts) should be addressed. Renewal part orders should be addressed to the Omaha factory where large compressors and condensing units will continue to be manufactured.

For the first time in five years, according to the Armstrong Cork Co., Building Materials Div., Lancaster, Pa., reasonably prompt delivery can be made of any of the company's industrial insulations, such as corkboard, mineral wool board, "Foamglas," cork covering, and most heat insulations. This is said to be possible for two reasons. "First, most of the shortages of raw materials, government restrictions, and wartime orders have been eliminated. Secondly, additions to manufacturing facilities are now completed."

An entirely new pricing policy on its fittings has been announced by The Parker Appliance Co. of Cleveland. The change introduces quantity discounts on all of the company's industrial lines of flared and flareless fittings for joining tubing. The new pricing arrangement replaces a previous flat pricing practice and will mean reduction in the price of many brass, steel, stainless steel, and aluminum fittings offered by the company. A more important consideration is said to be the simple and sounder pricing basis provided by the new policy.

It has recently been announced that Sterling, Inc., of Milwaukee, manufacturers of "Sterlco" heating specialties, controls, and pumps is now under new management. The stock of the company has been purchased by a group of Milwaukee businessmen and two of the new owners will be active in the management of the company. They are P. A. West, president of the new company, who will direct sales, and J. R. Ballard, vice president of manufacturing. To facilitate filling of current orders, the entire shop has been put on an overtime schedule and additions are being made to the company's personnel.

Airtherm Mfg. Co. of St. Louis, manufacturer of propeller fan type steam unit heaters, has recently made available an "Authorized Dealer" sign to identify dealers. The sign, 35x45 in., is reproduced in three

colors and is designed to stimulate the company's steam unit heater business.

Minneapolis-Honeywell Regulator Co.'s new air conditioning register is now in volume production. Developed during the war years, several hundred thousand of the new registers are scheduled for production during the current year. They are designed to incorporate the features of an air distribution grille and include volume adjustment and stackhead turning vanes.

A new factory addition to increase manufacturing space by one third is now under construction by Harvey-Whipple, Inc., Springfield, Mass. The new plant will occupy one half a city block, is of concrete and brick construction with steel framework, and will house production lines for the company's new boiler and warm air packaged units.

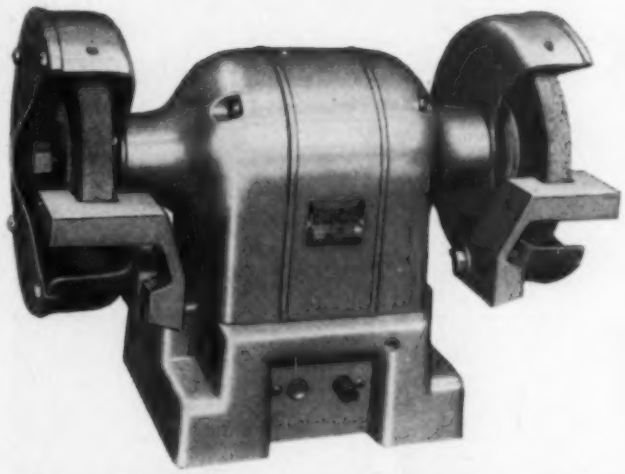
The Jessop Steel Co., Washington, Pa., and the Alan Wood Steel Co., Conshohocken, Pa., have completed a working agreement whereby the technical and manufacturing facilities of both companies are to be used for large tonnage production of stainless-clad steel sheets. The Jessop Co. is a producer of stainless and steel-clad steel, as well as tool steels, alloys, and other specialties, while the Alan Wood Steel Co. has been producing open hearth steels for many years.

Hess Warming & Ventilating Co., Chicago, has acquired a new plant at 1855 S. 54th St., Cicero (a Chicago suburb). The new plant, already equipped and in full operating order, is expected to triple production on all of the company's lines including furnaces, cabinets, and grain driers.

Prentice self-aligning pillow block bearings are again available in quantities according to Western Thermal Equipment Co. of Los Angeles, national distributors. New features include a porous bronze bearing surrounded by a large, felt oil reservoir which, according to the manufacturer, eliminates the necessity for frequent oiling. Improvements in manufacturing methods are said to permit closer tolerances and the use of new alloys is said to materially increase the life of the bearing.

Air Reduction Sales Co., New York City, has announced the availability of a new welding rod, the Airco No. 23A. This rod is of silicon-copper analysis while the previous rod offered for copper welding was of a phosphorus-deoxidized copper analysis. The new rod is designed to provide stronger welds and an excellent color match on copper. According to the manufacturer, it is the equal of silver-copper rods for this class of work.

NEW 6" HEAVY-DUTY BENCH GRINDER



for FASTER Tool Sharpening ... Grinding ... Wire Brushing

From streamlined housing to internal engineering, the new Black & Decker 6" *Heavy-Duty* Bench Grinder is designed to turn out better work, faster! Keeps a keen cutting edge on all your tools . . . grinds pipe, rings, connections, fixtures, etc. . . . wire-brushes, buffs, burnishes, polishes and finishes sheet metal . . . removes weld marks and saw or shear burrs.

READ THESE FACTS ON THIS *USEFUL* TOOL

- Modern, streamlined, die-cast housings improve working clearances and decrease weight.
- Powerful "constant-speed" B & D-built motor, mounted on ball bearings, maintains high operating speed under load.
- Steel wheel guards and covers give extra protection. Ample room for standard three-section wire wheel brush without changing the guard.
- U-shaped tool rests fit around grinding wheel for improved support in tool sharpening. Adjustable for wheel wear.
- Machined hole in base of Grinder provides for mounting attachments.
- Two-pole push-button switch is recessed in housing to prevent accidental contact, yet remains easy to reach.

Study the important facts on this tool shown above. Then ask your nearby Black & Decker Distributor for full details on these useful new Bench Grinders and other Portable Electric Tools for heating, piping and air conditioning work. Write today for your free copy of our catalog to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Maryland.

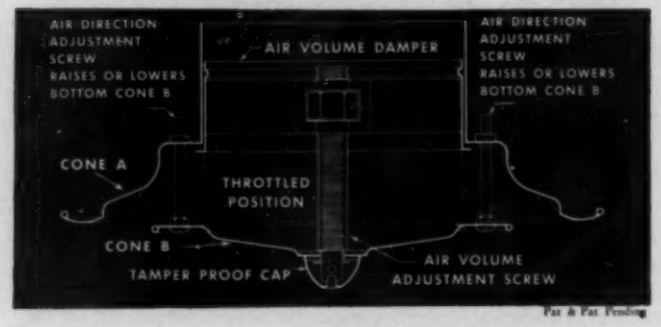
LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC TOOLS

How ADJUSTABLE air diffusers increase the efficiency of supply air distribution

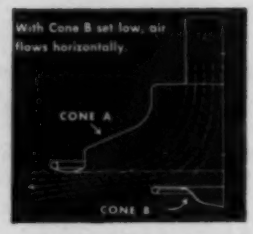
Kno-Draft Adjustable Diffusers offer all the advantages of draftless air diffusion plus fast system balancing and air pattern control

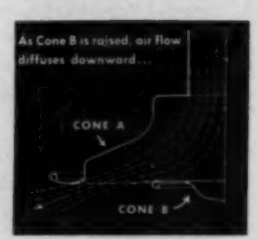

AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B
AIR VOLUME DAMPER
AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B
CONE A
THROTTLED POSITION
CONE B
TAMPER PROOF CAP
AIR VOLUME ADJUSTMENT SCREW

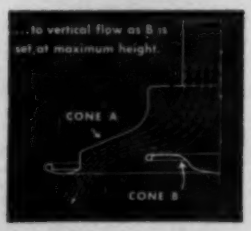
Pat. & Pat. Pending

Fast System Balancing: Volume damper regulates the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Positive Air Pattern Control: Air direction adjustment affords any angle of air discharge from vertical to horizontal needed to accommodate ceiling heights, individual or seasonal requirements. It can expel chilled air parallel to the ceiling or eject heated air downward to prevent stratification.







Specify Kno-Draft Adjustable Air Diffusers for better mixing control of room and supply air, more uniform temperatures throughout the occupied zone and noiseless, draftless air distribution.

Send for FREE handbook containing sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers. For your copy, please write Dept. D-15 on company letterhead.

W. B. CONNOR ENGINEERING CORP.
AIR DIFFUSION AIR PURIFICATION AIR RECOVERY
112 East 32nd Street — W.B. CONNOR — New York 16, N. Y.
IN CANADA: Douglas Engineering Co., Ltd., 1415 Bishop St., Montreal 25, P. Q.

Model A-316 "Twecotong" electrode holder has been announced by the Tweco Products Co. of Wichita, Kans. It is designed for the average job shop or maintenance welder using 200 amp welding equipment. Light weight, compactness, and ease of operation with a 95 lb bite on a 3/16 in. electrode are said to be some of the many features.

Automatic Switch Co. of New York City, manufacturers of solenoid valves and electromagnetic controls, is accepting orders on a firm price basis. The customary escalator clause has been withdrawn not only for its future acceptances but for all unfilled orders on hand.

The entire facilities of the Combustion Equipment Division of Todd Shipyards Corp. has been moved to a modern plant and office building at 81-16 45th Ave., Elmhurst, Queens, New York. Expansion on several fronts in the field of gas and oil burning equipment for industrial and commercial applications was one of the reasons for moving to the new plant which provides 40 per cent more floor space

Char-Gale Mfg. Co. of Minneapolis has announced its intention of greatly increasing the production of aluminum prefabricated duct fittings which, the company says, were developed as the result of wartime experience in handling aluminum for the production of aircraft assemblies and also as the result of 25 years experience in the heating and air conditioning field.

Skilsaw, Inc. has recently announced its entrance into the pneumatic tool field with a line of 28 models. These include pneumatic hammers, drills, screwdrivers, nut runners, and die grinders. With the acquisition of manufacturing facilities in Aurora, Ill., all pneumatic tools will be produced there, leaving the Chicago plant free to continue production of the electric "Skil Tool" line.

ASA Lists 864 Standards

The January 1947 list of 864 standards approved for industrial use by the American Standards Association is now available for general distribution. This revised list, which includes many standards developed under war procedure and now approved for peacetime use, is offered to interested trade, technical, and governmental bodies and individuals without charge.

The standards listed include definitions of technical terms, specifications for metals and other materials, methods of work, and methods of test for finished products. They are said to reach into every important engineering field including public and industrial safety, industrial medicine, and a wide variety of consumer goods.

The listing, designated as No. 4701, includes prices of the various standards and may be obtained from ASA headquarters, 70 E. 45th St., New York 17, N. Y.

NEW BOOKS & REPORTS

Finds the Heat Pump "Practical"

A review and analysis of the available operating data on some 22 domestic and commercial heat pump installations in this country has led E. B. Penrod, head, department of mechanical engineering, University of Kentucky, to the conclusion that the heat pump will work and that it is practical.

In a paper, A Review of Some Heat-Pump Installations, presented at the recent semi-annual meeting of the American Society of Mechanical Engineers, Mr. Penrod deals with the available design, test, and operating data for various types of installations which have been made in this country. He is chiefly concerned with the coefficients of performance, operating cost data (particularly as affected by the heat source), and load factors. His descriptions of both early and recent installations are rather brief and this is probably dictated by the relatively meager information on test results, etc., which is available.

The average COP for the 22 installations tabulated in this paper was found to be 3.4. Undoubtedly, many readers will question the accuracy of the figures; however, it should be remembered that Professor Penrod merely recorded data given him. It is to be noted that the author also questions some of the available test reports, such as those indicating COPs of 7.35 and 1.35—instances where the data were taken under adverse circumstances.

Along with other investigators he believes that the cost of operating a heat pump having a COP of 3.5 and utilizing electricity at 1 cent per kwhr is about equal to heating with oil or gas.

Identified as Paper No. 47-SA-10, the report may be obtained from ASME headquarters, 29 W. 39th St., New York 18, N. Y.

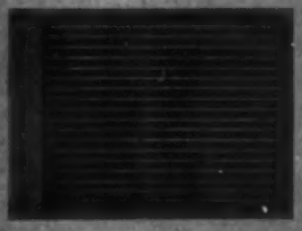
Prefabricated Floors and Ceilings Used in Radiant Heating, Cooling

Experience with radiant heating led G. Lorne Wiggs, consulting engineer, Montreal, Canada, to the conclusion that where pipe coils are embedded in reinforced concrete slabs, the coils often interfere with the placement of reinforcing rods, and he observed that frequently the rods had to run directly adjacent to the radiant heating pipes. In the belief that it would be possible to use radiant heating pipes as reinforcement, an extensive study was made by Mr. Wiggs, together with C. S. Kane, well-known Canadian structural engineer.

After extensive investigation and study, detailed working drawings for the prefabricated panels for a single bay of a new office building were prepared. The panels were designed to be made up not only with the floor joists, the floor slab, and the plaster ceiling, but also to incorporate the necessary radiant heating coils, the lighting ceiling outlets, a system of underfloor ducts

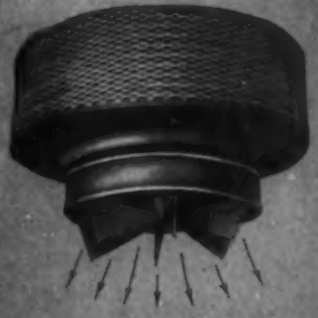
McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

for the telephone wiring, electric floor outlets, and automatic sprinkler piping. The first installation using this system is now being made in a small office building in Sorel, Que.

The fabrication and installation of these prefabricated panels are described in a paper, Radiant Heating and Cooling and Their Application to Prefabricated Floor and Ceiling Construction, which was recently presented by Mr. Wiggs before the Montreal branch of the Engineering Institute of Canada.

According to the author this type of prefabrication offers many advantages, such as shorter construction time for the building, a reduction in the amount of form work on the job to small proportions, elimination of all floor shoring, and reduction to very small proportions of the amount of scaffolding required. This greatly reduces the fire hazard during the construction of fire resistive buildings.

Another noteworthy advantage, says the author, is the elimination of the necessity for temporary wood staging or planking for the protection of workers erecting the structural steel. At the same time, this system provides early in the construction period adequate storage and working space for the trades employed on the building construction. The most noteworthy advantage is probably the reduction in on-site labor.

In addition to describing the prefabricated panel system, Mr. Wiggs briefly reviews the fundamentals of radiant heating, covering such factors as convection, radiant heat, mean radiant temperatures, etc. The advantages of radiant cooling are also mentioned by the author, who states that for such systems, the pipe coils should be embedded in the ceiling plaster except in hospital operating rooms where they should be built into the walls. Radiant cooling, combined with summer air conditioning, says Mr. Wiggs, offers many advantages over a straight summer air conditioning system. It will provide more uniform room temperatures, a substantial reduction in the size of ductwork and air conditioning equipment, a reduction in the air quantities circulated, and, in all probability, a lower operating cost.

Data on Building Insulations Given in Semi-Technical Discussion

Thermal Insulation of Buildings is not intended to be an exhaustive treatise on thermal insulation of structures, but rather a nontechnical to semi-technical discussion of the subject for home owners, builders, architects, students, and insulation salesmen. The author, Paul D. Close, technical advisor, Simpson Logging Co., was formerly technical secretary of the Insulation Board Institute and also of the American Society of Heating and Ventilating Engineers. He presents information and data on the various economic and comfort advantages of insulation and explains how various materials are used.

In addition to covering the definition, purpose, and advantages of insulation, the theory and basic principles are briefly covered. Heat loss coefficients are defined and tabulated, and the calculation of heat losses and fuel savings is demonstrated. Quite properly, attention has been paid to condensation and its prevention

Announcing!

EAGAN TURBINE PUMPS

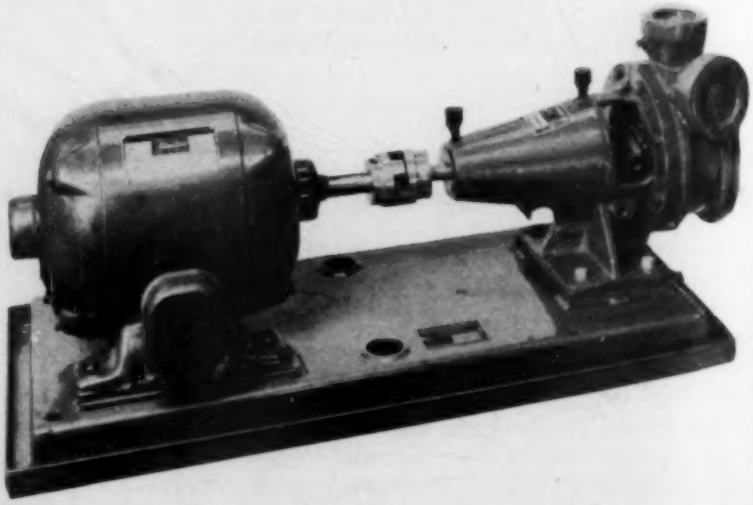
CAPACITIES to 250 G.P.M.

PRESSURES to 200 P.S.I.

Pumps ANY CLEAN LIQUID — up to 500 SSU Viscosity

Check these outstanding features of the new EAGAN Turbine Pump

1. RENEWABLE HEADS, both inboard and outboard-bronze for bronze fitted pumps.
2. TWO ball bearings on extra large STAINLESS STEEL Shaft.
3. REVOLVABLE casing, for eight different port locations.
4. Only ONE stuffing box, with tapped drain pocket.
5. SEPARATE FRAME, permitting alloy heads yet cast iron frame.



Write for catalogues on this addition to the EAGAN line of CONDENSATE RETURN, BOILER FEED, and VACUUM HEATING PUMPS

WALTER H. EAGAN CO.

2336-38 FAIRMOUNT AVENUE, PHILADELPHIA, PA.

on both surfaces and in walls and ceilings. Attic venting and the use of various types of vapor barriers are a part of this discussion.

Of general interest is the chapter covering the various types of insulations which are commercially available, and the following chapter on how to apply insulating materials. As a means of promoting the health of farm animals and increasing financial returns, the author considers the insulation of farm buildings, other than residences, important. Recommendations are given based on requirements to prevent condensation, heat available from the animals, and geographical location of the farm.

A tabulation of insulation manufacturers and trade names is included in this 104+vi page book. Published by Reinhold Publishing Corp., 330 W. 42nd St., New York City, this 6 x 9 in. volume is paper covered, plastic spiral bound, and is priced at $1.75.

ASA Lists 200 Safety Standards

Approximately 200 standards covering safety and industrial health are listed in a new catalog published by the American Standards Association. The 20 page booklet not only lists the standards and prices but gives a brief description of their contents which are said to constitute a symposium of the best methods of meeting the technical problems of safety.

Copies may be obtained from ASA Headquarters at 70 E. 45th St., New York 17, N. Y.

Narrow Industrial Buildings Better Suited to Natural Ventilation

Higher air movements prevailing in narrow, as compared to relatively wide, buildings and the lack of significant increase in air movement when roof ventilators are used under certain conditions are among the conclusions to be drawn from the data presented in a pamphlet, Some Observations on Natural Ventilation, Air-Movement, and Factory Design by N. H. Shaw, R. W. Prunster, and G. Blackburn.

The data presented in this paper provide some relevant information on air movements and are based on a study in four Australian factories of some aspects of the relationship between factory design and the air movements induced in buildings by natural ventilation.

Published in the form of a 36 page pamphlet and identified as Technical Report No. 3, the paper may be obtained from the industrial welfare division, Department of Labour and National Service, Commonwealth of Australia, Nicholas Bldg., 37 Swanston St., Melbourne.

Specifications on Stainless Steel Welding Electrodes Cover Tests

With the issuance of the Tentative Specifications for Corrosion-Resisting Chromium-Nickel Steel Welding Electrodes (AWS designation: A5.4-46T; ASTM designation A298-46T) the AWS-ASTM Committee on Filler Metal has completed one more step in a program which is intended ultimately to provide a complete set of specifications for all types of filler metal used in welding ferrous and nonferrous metals by the various welding processes.

Copies of the specifications, which provide 24 classifications of electrodes with test requirements, may be

There is a FEDDERS UNIT HEATER MAN

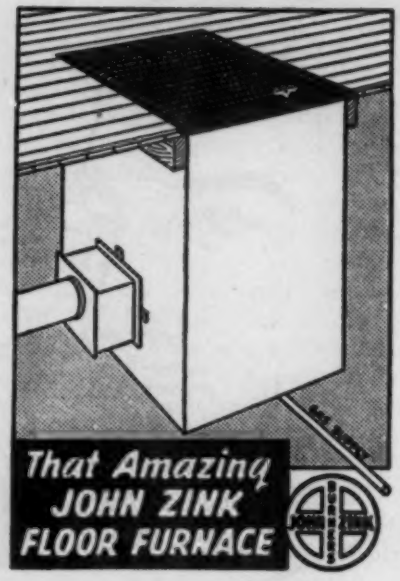
As near as your PHONE

Classified telephone directories in principal cities from coast to coast list the Fedders representative under the heading HEATERS—UNIT. Handsome, sturdy cabinets...full protection against expansion stresses...compact size... quiet operation are typical Fedders features worth looking into.

Built in a complete well-graduated range of capacities for horizontal and downblow installations. Call in your Fedders Unit Heater man.

FEDDERS-QUIGAN CORPORATION
BUFFALO 7 • NEW YORK

JOHN ZINK FLOOR FURNACE



FEATURES—

★ *Efficiency*
★ *Quietness*
★ *Durability*
★ *Economy*

One large gas port, eliminates burner stoppage. Large full length combustion chamber giving uniform warm air temperature without overheat. Proper design makes possible a light air hood which is easily removed for cleaning the furnace. The gas burner is a pre-mix type, made of high grade cast iron, equipped with a pilot light. Automatic controls are available. SIZES: No. 35 input rating 35,000 B.t.u./hr.

No. 50 input rating 50,000 B.t.u./hr.

— Write for Literature —

John Zink Company

4401 South Peoria

TULSA, OKLAHOMA

New York - Salt Lake City - Houston - Los Angeles

obtained in the form of a 13 page, 6x9 in. booklet at 25 cents each from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Specifications Cover Mineral Wool Block and Board Insulation

The new Federal Specifications, HH-1-564, on mineral wool block and board insulation have been issued by the Government as purchasing specifications for the Army, Navy and Maritime Commission.

The new specifications define as block insulation those rigid shapes which do not exceed 12 by 36 in., and as board those which are supplied in larger sizes. Four classes of mineral wool compacts are set up by temperature range: for surfaces up to 225 F, up to 500 F, up to 1000 F, and up to 1500 F. Specifications for breaking strengths, shrinkage, water absorption, and thermal conductivities are included. It is to be noted that these are minimum specifications only and are generally exceeded by present day mineral wool insulation producers.

Copies of these specifications may be obtained from the Superintendent of Documents, Washington, D. C., at 5 cents per copy.

Operation, Application of Steam Traps and Air Vents Described

Stressing that old knowledge and incorrect applications of steam traps should be forgotten before a steam using plant can be run economically, a new text, Steam Trapping and Air Venting, by L. G. Northcroft, provides a good deal of information on correct methods of trapping, venting, and draining condensate.

The author describes the various types of steam traps and air vents, their operation and application in installations such as heating equipment, boiling pans, kettles, steaming ovens, hot plates, sterilizers, dryers, preheaters, etc. The book contains many illustrations, diagrams, tables, examples, and an index and should be a useful reference book for engineering students, the heating engineer, and the operating engineer using steam equipment.

This cloth bound text contains 172, 5½x9 in. pages, is published by the Chemical Publishing Company, Inc., 26 Court St., Dept. Y, Brooklyn 2, N. Y., and is priced at $4.50.

Offers Data on Atmospheric Weathering of Stainless Steels

The American Society for Testing Materials has published a Symposium on Atmospheric Weathering of Corrosion-Resistant Steels. This symposium, presented at the Society's 1946 annual meeting, is intended to give in convenient form an up-to-date picture, based on the latest data, of the behavior of the so-called stainless steels when exposed to the atmosphere. The publication incorporates a good deal of information and data that have been developed not only under the auspices of the Society's Committee A-10 on Iron-Chromium-Nickel Alloys but by leading organizations concerned with the problem.

Copies of this 92 page, paper-covered publication can be obtained from the ASTM headquarters, 1916 Race St., Philadelphia 3, Pa. at $1.50 per copy.

Electric Radiant Heating Economically Practical With 1c Rate

In the opinion of L. N. Roberson electric radiant panel heating is economically practical where electric rates of 1c per kwhr are available. Mr. Roberson, president of a company bearing his name, has installed many of these systems in and around Seattle during the last five or six years and is the author of a paper on Electric Radiant Heating, published in the Vol. 27, No. 9 issue of Progressive Architecture.

He points out that a radiant panel system using electricity has all of the advantages of panel heating, requires no heating plant or fuel storage space, and lends itself to individual room control. As a result of his experience, he says that for wall or ceiling panels, conventional plaster and conventional finishes are entirely satisfactory, and in all cases the calculations for electric panels are the same as for other forms of radiant heating, though he uses a number of his own shortcuts.

In 1940 the author explored the possibilities of using electric heat in plaster. He found that while it had been used in England since about 1907, little design data were available. His company developed a special cable insulated with a plastic of high water, acid, and alkali resistance, and today there are numerous installations in which this cable is used.

His systems consist of standardized lengths of cable secured in intimate contact with wall, floor, or ceiling surfacing materials, connected through ordinary junction boxes to a power source, with each panel or group of panels controlled by a room thermostat and wall switch. He states that examination of the comfort zone for radiant heating shows that, as the air temperature approaches 70 F, the panel temperature also approaches 70 F if it is of the correct size. As the outdoor temperature drops, the increased radiation loss causes a demand for more heat, resulting in increased panel temperatures. He believes this makes a simpler installation to control than would be the case to maintain an air temperature of, say, 64 F and a panel temperature sufficient to balance outside conditions, particularly when outside temperatures rise slightly above the inside air temperature—a condition which would call for heat when no heat would be supplied by the panel if it were controlled by air temperature alone. He recognizes that there are controls on the market for meeting conditions of this type but believes that the installation costs would be increased considerably when used with electric radiant heat where each room is individually controlled.

Some of his observations regarding design considerations are: (1) concrete floors show condensation effects by the presence of sweating around the edges of rugs and carpets when only the ceiling, walls, or both are the sources of heat, (2) a concrete floor requires about four hours to come up to temperature, drops 10 deg overnight when turned off, and requires about a week to drop back to the normal temperature of the soil below it, (3) plaster ceilings and walls reach a comfortable temperature in approximately 30 min from a cold start, although it may be several hours before the heat shuts off for the first time, and after the plaster has a sufficient heat charge, the element is rarely on more than one-third of the time, and (4)

PEERLESS Horizontal Centrifugal PUMPS

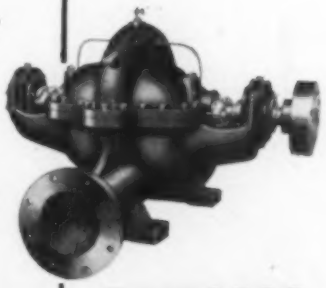
(Formerly Dayton-Dowd)

TYPE A PUMPS for GENERAL and PROCESS SERVICES

CAPACITIES: 50 to 70,000 g. p. m.

PEERLESS PUMPS

● The Peerless Type A pump is characteristic of the entire line of high quality, heavy duty horizontal centrifugal pumps, manufactured by Peerless to serve the diversified pump demands of industry, municipalities and water works everywhere.



PEERLESS TYPE A Centrifugal PUMPS

General Specifications: *Capacities*, from 50 to 70,000 g.p.m.; *Heads*, 15 to 300 feet; *Sizes*, 2" to 42" discharge; *Drives*, electric and other types from 1 to 1000 h.p.; *Type*, single stage, double suction, split-case, ball bearing. REQUEST DESCRIPTIVE BULLETIN.

PLAN WITH PEERLESS

For all your pumping requirements, plan with Peerless. Peerless' comprehensive line of pumps includes Underwriters' approved Fire Pumps for plant fire protection, Boiler Feed and Pipe Line pumps and scores of other vertical and horizontal types producing capacities from 10 to 220,000 g.p.m.

PEERLESS PUMP DIVISION

FOOD MACHINERY CORPORATION

Factories: Canton 6, Ohio • Quincy, Ill. • Los Angeles 31, Calif.

District Offices:

Canton 2, Ohio; Philadelphia: Suburban Square, Ardmore, Pa.; Atlanta: Rutland Bldg., Decatur, Ga.; Dallas 1, Texas; Los Angeles 31, California.

Although the drain water that leaked on this woman's washing is gray, she sees *red*. She'll tell the plumber what she thinks of him.

Smart plumbers don't install fittings which are likely to have hidden defects. They spend a trifle more for the best, thus avoiding costly call-backs and embarrassing call-downs.

The "K" line of precision-cast, precision-machined, minutely inspected fittings includes . . .

Standard and Extra Heavy Cast-Iron Screwed Fittings
Standard and Extra Heavy Companion Flanges
Standard Flanged Cast Fittings
Drainage Fittings

CATALOG ON REQUEST

KUHNS BROTHERS CO.
DAYTON 1, OHIO

K PRECISION FITTINGS

Combined market facilities at Malleable Iron Fittings Co., Branford, Conn., and at Kuhns Bros. Co., Dayton, Ohio

double glazing of windows apparently causes no greater heat savings than single glass in electric radiant heated homes—his data show a lower power consumption for single glass, though he stresses that more information, secured under controlled conditions is required to settle this point.

Mr. Roberson advocates the use of wall or floor panels to eliminate cold "shadows" under tables and desks. He finds that when the angle from the extreme sources of ceiling heat is less than 45 deg off the vertical, cold spots are encountered. In such cases, he says, part of the heat should come from a wall or floor panel.

For attaching cable to plaster lath or plaster board he uses insulated staples, patching plaster, or loops of asbestos cord attached to the plaster board by means of a stapling machine. In some cases the cable is simply secured to the surface to be plastered. In any event no other metallic reinforcing should be used at any point where it will have to be crossed by the cable; this condition will cause a hum in the reinforcing when the heating element is turned on.

In regard to design calculations the author tries to obtain a U factor of 0.005 to 0.007 for insulated ceilings (usually obtained by the use of 3½ or 4 in. of fill type insulation) and an exposed wall and floor factor of approximately 0.25. For concrete floor slabs on the ground a factor of 0.19 is used providing suitable insulation is used between the slab and the footings or exposed wall. If insulation is not used the slab factor is increased to 0.30. Soil temperatures are taken to be 50 F. When the U factors are approximately as stated in the foregoing and the minimum outside design temperature is 0 F or above, a quick check of the heating load is obtained by allowing 1½ watts per cu ft for large rooms and 2 watts per cu ft for rooms under 2000 cu ft.

Standard on Hot Water Supply Boilers Recommended

A recommended commercial standard on testing and rating hand-fired hot water supply boilers, which was proposed by the Institute of Boiler and Radiator Manufacturers, is now being distributed by the National Bureau of Standards to the trade for written acceptance.

All sizes of hot water supply boilers are covered and the rating is defined as the maximum output in Btu per hour together with the capacity in gallons per minute of water heated 100 F in 3 hr. Requirements include the recommendation of a minimum tank size based on maximum output. In the case of smaller boilers, limitation of output under banked conditions is intended to preclude the possibility of limited tank size.

Copies of this proposed standard, identified as TS-4281, may be obtained from the U. S. Department of Commerce, National Bureau of Standards, Washington 25, D. C.

Explains Aluminum Heat Treatment For Both Technician and Layman

While aluminum alloys have become one of our most important metals, little information on heat treating them has been available. To meet this need, an unusual

treatment of the subject is contained in a process manual, Heat Treating Aluminum Alloys, which is designed to provide information in a form readily usable by both the nontechnical man and the trained technician.

The first section of the book breaks down the subject into simplified concepts which the nontechnical reader can follow and so obtain a basic understanding of the metallurgy and heat treatment. The second section presents in brief tabular form the recommended thermal treatments for the various aluminum alloys.

Section three, for the metallurgist and operating personnel, contains a more technical discussion of the various thermal treatments as well as detailed information on possible difficulties and suggestions for their cure. Also abnormal as well as normal metallographic structures are illustrated by a series of photomicrographs.

This handy wirebound, 6x9 in. book contains 144 pages, 81 illustrations, 13 tables, and 18 photomicrographs. It is available from Reynolds Metals Co., Dept. 47, 2500 S. Third St., Louisville 1, Ky. The price is $1.00.

Latest Specifications, Test Procedures in ASTM Standards

With more than 1400 standards, specifications, tests, and definitions for a wide range of materials, and containing almost 7000 pages, the 1946 Book of ASTM Standards has been issued in five parts and contains the latest specifications and test procedures.

Each part of the book has a complete subject index (from 36 to 44 pages). There are two extensive tables of contents. The first lists all standards under general headings; the second according to the serial designations of the standards. These features are designed to facilitate reference to any subjects covered.

According to the society, the great growth in the number and volume of standards and tentatives has compelled the division of the book into five separate parts as follows: Part IA—ferrous metals, Part IB—nonferrous metals, Part II—nonmetallic materials (constructional), Part IIIA—nonmetallic materials (coal and coke, petroleum products, aromatic hydrocarbons, soaps, waters, textiles, and gaseous fuels), Part IIIB—nonmetallic materials (electrical insulating materials, plastics, rubber, paper, shipping containers, and adhesives).

To keep these books up to date, a supplement will be issued to each part late in 1947, and a complete 240 page index to the standards is furnished without additional charge.

Copies may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., as follows:

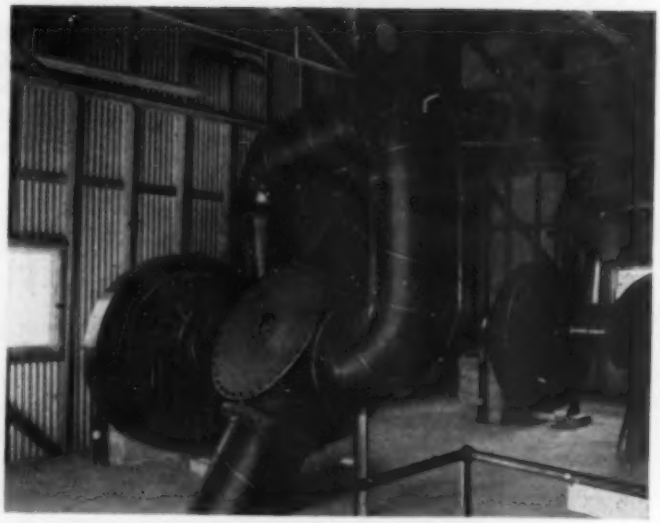
Parts IA, IB, IIIA, or IIIB, $8.00 each; Part II, $12.00; a complete set of all parts, $44.00. These prices are for cloth bound editions. An additional charge of $2.00 per part is made for half leather copies.

AGA Schedules 1948 Convention

The 1948 convention of the American Gas Association, 420 Lexington Ave., New York City, will be held in Atlantic City the week of October 4.

NAYLOR Light-weight PIPE...

THE IDEAL PIPE FOR VENTILATING SERVICE



Consider these Naylor Pipe advantages:

Light weight with greater strength. Tight . . . leakfree. Always accurate in diameter . . . ends match correctly. Holds true cylindrical form.

The Naylor structure creates a reinforcing truss which assures additional collapse strength and permits the use of lighter gauge material without any sacrifice of performance. The larger the diameter pipe required, the more this is true. Thus, Naylor Pipe can be used on ventilating jobs that no other light-weight pipe can handle.

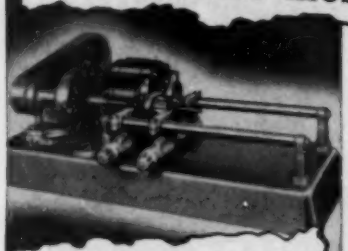
Sizes from 4" to 30" in diameter. All types of fittings and connections. Fabrications to customers' requirements. Write for Naylor Catalog No. 44.

NAYLOR PIPE COMPANY

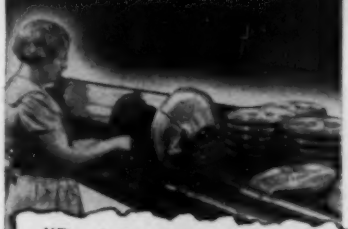
1251 East 92nd Street • Chicago 19, Illinois

New York Office: 350 Madison Avenue • New York 17, N.Y.

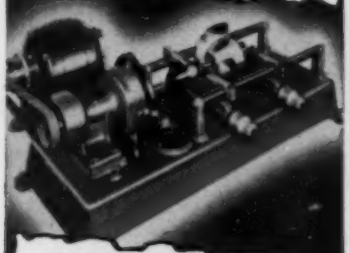
Reports like these from users*. . .



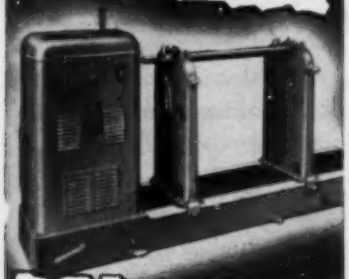
"Balancing Armatures at Production Line Speed"



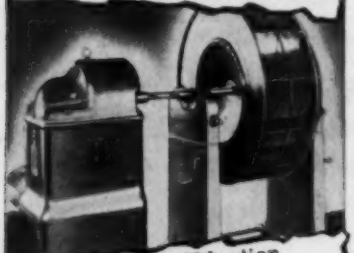
"Band-Saw Wheels Made Smoother Operating"



"Speedy Balancing of Propellers to 3 Mils"



"The Model 375 Has Been Found Highly Adaptable"



"Eliminated Vibration, Increased Bearing Life in Giant Fan Wheels"

prove how Bear Dy-Namic Balancing can help you!

The experience of leading manufacturers has shown how Bear Dy-Namic and Static Balancing can cut time and labor costs and give accurate, dependable results . . . at production line speed. Bear Balancing Equipment is engineered for low cost, extreme sensitivity and simplicity of operation . . . any shop hand can learn Bear Balancing in half a day.

There's a Bear Balancer for every rotating body . . .

From tiny armatures to giant crankshafts . . . from a few ounces to several tons . . . there's a Bear Balancer available to handle every job . . . in fact, practically everything that rotates can, and should, be Bear Balanced.

If the equipment you manufacture includes a rotating, rolling or revolving body, Bear invites you to send a sample or blue print of the body to be balanced. Give weight, dimensions and speed at which equipment operates. Bear Engineers will send complete details on the machine adapted to your particular problems. There is no obligation.

*Reports from actual Bear Equipment Users will be sent on request. BEAR MFG. CO., Dept. H-16, Rock Island, Illinois. 2337R

Write for the Bear Industrial Bulletin TODAY!

BEAR

COMBINATION

STATIC AND DY-NAMIC BALANCING MACHINES

MEETINGS & CONVENTIONS

Sponsors Industrial Hydraulics Conference

The third annual meeting of the National Conference on Industrial Hydraulics (formerly the Hydraulic Machinery Conference) will be held, October 16 and 17, at the Hotel Continental in Chicago. The conference is sponsored by Armour Research Foundation and the graduate school of Illinois Institute of Technology in cooperation with the Chicago sections of the SAE, ASCE, and ASME.

Additional information may be obtained from Dr. V. L. Streeter, Armour Research Foundation, Technology Center, Chicago 16, Ill.

AWS Changes Date of Exposition

The American Welding Society, 33 W. 39th St., New York City, has announced that the date for the opening of the National Metal Congress and Exposition, to be held in Chicago, has been changed from October 19 to the preceding day, the 18th. The dates for the exposition are now October 18 to 24.

The society's annual meeting will be held at the Sherman hotel, and as usual, concurrently with the exposition. M. M. Kelly, society secretary, has suggested that those who wish to change the date of their arrival because of the change in exposition dates, contact the hotel immediately.

Chemical Show to be Held in San Francisco

An industrial chemical conference and display for the western states and Pacific area are scheduled for the Civic Auditorium in San Francisco, Oct. 21-25. This is the first regularly scheduled Pacific Chemical Exposition and will be presented by the California section of the American Chemical Society, whose headquarters is at the Whitcomb hotel, San Francisco.

ASME Members to Meet in Atlantic City

The 1947 annual meeting of The American Society of Mechanical Engineers, 29 W. 39th St., New York City, will be held at the Chalfonte and Haddon Hall hotels, Atlantic City, December 1-5. This will be only the third time in the society's history that it has held the largest of its national gatherings outside of New York City.

Some of the other meetings scheduled for the remainder of the year include:

- Fall meeting, Salt Lake City, Utah, Hotel Utah, Sept. 1-4
- Industrial instruments and regulators division, Chicago, Sept. 8-9
- Petroleum mechanical engineering conference, Houston, Tex., Oct. 6-8
- Fuels division, joint meeting with the coal division of the AIMME, Cincinnati, Ohio, Oct. 20-22

REMA to Set Aside Special Times for Groups to Inspect Show

Special times will be set aside for wholesalers, contractors, and service engineers in the refrigeration industry to view the 5th All-Industry Refrigeration and Air Conditioning Exposition in Cleveland, January 26 to 29, 1948, according to an announcement from the Refrigeration Equipment Manufacturers Association, 1107 Clark Bldg., Pittsburgh 22, Pa. The hours of 10:00 a. m. to 2:00 p. m., January 26, will be reserved for wholesalers. The second day of the exposition, Tuesday, January 27, will be devoted to exclusive showings for contractors and service engineers. The balance of the show hours will be open to all groups in the industry, according to REMA. This show will be a closed trade event and will not be open to the public.

8th Heating, Ventilating, and Air Conditioning Exposition to be Held in New York

The 8th International Heating, Ventilating, and Air Conditioning Exposition will occupy all of the available display space in Grand Central Palace, New York City, the week of February 2, 1948.

Exhibitors' response to date indicates that all space will be exhausted in advance of the opening. However, as spaces are chosen by exhibitors individually rather than being assigned in blocks, some choice locations are still available, according to C. F. Roth of the International Exposition Co., Grand Central Palace, New York, N. Y., managers of the show.

The exposition will again be under the direct auspices of the ASHVE, and the Society's 54th annual meeting will be held concurrently.

OHI Schedules Chicago Convention and Exhibition

The Oil-Heat Institute of America, 30 Rockefeller Plaza, New York City, is planning to hold a convention and exhibition of products at the Coliseum in Chicago, the week of April 5, 1948.

Stresses Functions of Controls in Smokeless Boiler Operation

With an efficient system of boiler control, coordinated to maintain fuel feed, air flow, and furnace draft at the correct values, it is possible to operate properly designed furnaces with little, if any, smoke, according to P. S. Dickey, chief engineer, Bailey Meter Co., in a recent paper presented before the American Society of Mechanical Engineers. He said that man's ever increasing consciousness of the smoke and fly ash nuisance is a contributing factor to the demand for boiler and furnace control, and he pointed out that one of the functions of control is to keep the smoke and fly ash at a minimum.

Mr. Dickey also stated that firemen can contribute immensely to the problem of smoke control. It has long been known that an intelligent, well trained fireman can operate a furnace in such a manner that no smoke will appear even though automatic control is not in use. However, this was not recommended as there is a tendency, he said, to use an excessive amount of excess air.

THERE is a wealth of practical, up-to-date factual information about expansion joints and flexible connectors packed into this new 60-page catalog compiled by the technical staff of Zallea Brothers & Johnson.

For instance, twenty double-pages offer specific, usable data on the many types of Zallea expansion joints. There's a full description of the manufacturing process for every expansion joint that includes welding and forming, annealing, pickling and passivating.

In addition you'll find detailed discussions on how to select the proper expansion joint for each specific application and the advantages of each, *plus* many charts and diagrams. Also, it's profusely illustrated with photographs of actual applications.

Never before has such a complete, comprehensive catalog been published on expansion joints and flexible connectors exclusively. Catalog 47 is *FREE* . . . a request on your company letterhead will bring it to you. Use it as a guide or as a permanent reference source. And when unusual conditions confront you, ask for the assistance of our technical specialists. *Zallea Brothers & Johnson, 816 Locust Street, Wilmington 99, Del.*

Zallea
EXPANSION JOINTS
WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 177. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Adjustable V Belts

No. 6560—The new 24 page "Veelos" v belt catalog describes features, together with construction and installation details, of the adjustable v belts offered by Manheim Mfg. & Belting Co., Manheim, Pa. Thirteen pages of application photos showing installations in a wide variety of industries are also included.

Air Conditioning Units

No. 6561—A new, illustrated catalog covers the two lines of "Latenaire" and "Sensaire" air conditioning units designed by the American Coils Co., Inc., 360 Thomas St., Newark 5, N. J. Included in these "Amcoil" lines are remote and self-contained models of both the floor and wall types as well as duct type coils for use in conjunction with larger air conditioning systems. Specifications and engineering data for the units will be found in this catalog which also includes a calculator chart for use in selecting the recommended model and capacity for various conditions.

Air Diffuser Panels

No. 6562—"Multi-Vent" panels are an assembly of control plate and frame, orificed adjustable total displacement valve, and perforated distribution plate. The unit is installed in the ceiling, receiving air supply from the duct work or plenum above the panel. Operating on the pressure displacement principle, the device is designed to provide widespread air distribution at low velocity and to be independent of duct velocity.

The panels are described in an unusually well illustrated, 58 page, bound booklet (Bulletin 6510) published by the Pyle-National Co., 1334-58 N. Kostner Ave., Chicago 51, Ill. After reviewing the various methods of air distribution which have been commonly used during the last 25 years or more, the bulletin cites the experiences and developmental work which has resulted in these panels. One of the basic features stressed is the use of low velocities at air discharge. This is said to permit a greater diffusion temperature difference (as high as 25 deg under an 8 ft. ceiling) which results in less air being required for a given load. The net result, says the manufacturer, is smaller ducts, fans, filter, and coils.

Many typical applications, including railroad cars, are illustrated, and installation methods and the technique of balancing and adjusting is shown. Standard panel sizes, performance data, installation procedures, dimensions, and recommended selection methods are included, together with detailed drawings and other pertinent information.

Saves Water and Nuisance
Have you ever felt a sudden mist on a clear day near a water cooling tower? That mist is "drift loss" and to reduce this to an almost imperceptible minimum, Offset Herringbone Eliminators are placed near the top of C. H. Wheeler Cooling Towers, as illustrated above. Air conditioning systems with C. H. Wheeler Cooling Towers thus save a maximum amount of water. Send us your specs.; we'll design a tower for your needs with outside casing of wood, steel, masonry or transite, erect it and guarantee results. Bulletin on request.
C. H. WHEELER MFG. CO.
1826 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES
Three Cell, Induced Draft Tower, Redwood Construction
C.H. Wheeler
STEAM CONDENSERS · AIR EJECTORS
COOLING TOWERS · HEAT EXCHANGERS
OF PHILADELPHIA

Automatic Air Filter

No. 6563—"Uniflo" automatic, self-cleaning air filters, featuring oil-coated filter cells which are designed to provide a continuous change of direction, an improved method of rotating the filter curtain so that the air moves through each of the two curtains of cells in the same direction, and an improved cleaning system, are described in Bulletin 201 issued by Continental Air Filters, Inc., Louisville, Ky.

Centrifugal Blowers

No. 6564—The line of centrifugal blowers, both forward and backward curve blade type, together with blower accessories, offered by New York Blower Co., 32nd St. and Shields Ave., Chicago 16, Ill., is covered in a 31 page bulletin (No. 471). Details of construction, dimensions, and performance data are included for these Type ME fans which are available in a wide range of sizes.

Control Instruments for Hotel Heating, Conditioning

No. 6565—Automatic control instruments designed to make hotel operations more efficient and to provide greater guest satisfaction are covered in a new handbook published by Minneapolis-Honeywell Regulator Company, 2604 4th Ave., S., Minneapolis 8, Minn. Among the new controls listed is a window switch, recently perfected by the company, which automatically shuts off radiator valves whenever a window is opened. Controls for process steam used in hotel kitchens, laundries, and bathrooms, together with controls and recording instruments for boiler rooms and air conditioning systems are also discussed.

Corrosion Resistant Valves and Fittings

No. 6566—Descriptions of all standard "Aloyco" corrosion resistant valves and fittings, together with photographs, cross sections, dimensional data, and listings of alloys in which each style is stocked are contained in a new catalog (No. 47) issued by Alloy Steel Products Co., Linden, N.J. Specific alloy recommendations for handling nearly 400 different corrosive applications are included.

External Protection of Large Electric Motors

No. 6567—External Motor Protection Pays (for large industrial drives) and How to Figure Voltage Drop (particularly in motor starting) are featured discussions in the Vol. 8, No. 2 issue of the E-M Synchronizer, the house organ of Electric Machinery Mfg. Co., Minneapolis 14, Minn. Protective arrangements for motors are also defined and are illustrated with diagrams and photographs.

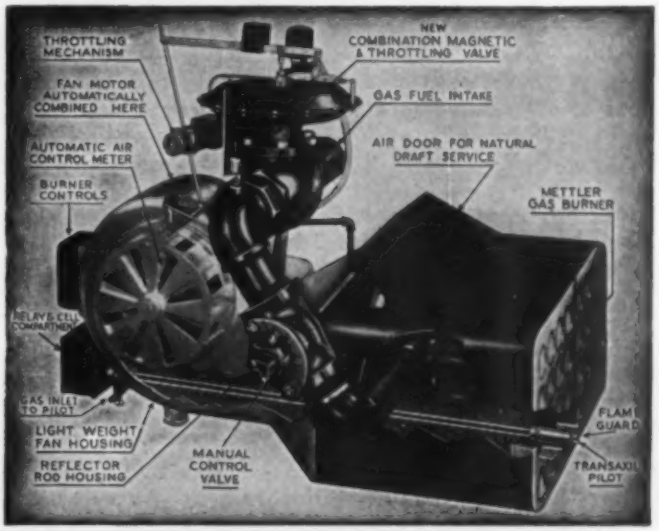
Fans and Blowers

No. 6568—The many types of air moving equipment offered by the General Blower Co., Morton Grove, Ill., are briefly covered in a new eight page booklet called

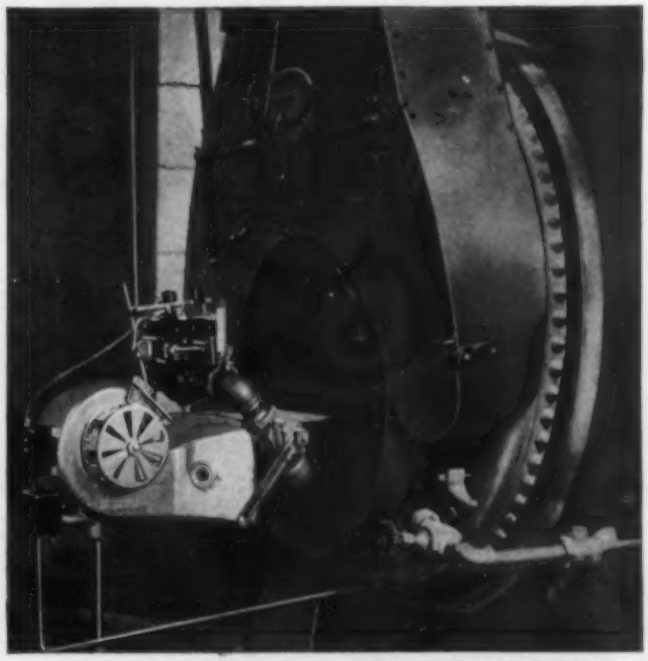
The Gas Burner

EXPERTO CREDE

"FAN-AIR"



Picture reveals essential and highly desirable POINTS of "Fan-Air" mech'l draft gas burners. Not just a gas burner but a COMPLETE AND FULLY AUTOMATIC BURNER SYSTEM, factory tested and ready for application when received. It's the most modern gas burner. Why be satisfied with less—when all these tangible advantages are so readily available. It's easier to install, too.



NOTHING ELSE LIKE IT FOR SCOTCH MARINE BOILERS

Sizes 5 to 300 H.P. *Prompt Shipments*

LEE B. METTLER CO.

406 South Main Street

LOS ANGELES 13 CALIFORNIA

Lungs for Industry. Among the products described are centrifugal blowers, welding fume exhausters, steel plate exhausters, multiblade exhausters, disc and propeller fans, rotary positive exhausters, insulation blowing machines, roof ventilators, and hay drying equipment.

Heating System Temperature Controls

No. 6569—The "Weather-Man" temperature control system for operating gas burners, oil burners, stokers, circulating pumps, fans, motor valves, or zone control valves is described in a new folder issued by the Automatic Devices Co., 53 W. Jackson Blvd., Chicago. The system operates to anticipate building heat requirements. The time at which heating starts in the morning and shuts off at night is varied in accordance with weather changes.

Heating, Ventilating, Air Conditioning Controls for Schools

No. 6570—A new handbook on heating, ventilating, and air conditioning controls for the modern school has been published by Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8, Minn. Setting forth in nontechnical terms information on control systems, the booklet describes a number of instruments designed especially for schools.

Interchangeability in Regulators

No. 6571—A new four page bulletin entitled Interchangeability, which discusses the four important phases of interchangeability as applied to regulators, has recently been issued by Leslie Co., 51 Delafield Ave., Lyndhurst, N. J., manufacturers of regulators, controllers, strainers, and whistles. Designated as Bulletin 468, the booklet lists, in table form, key internal working parts which are renewable and interchangeable. Included also is information on standardization of regulating valves as quoted from Simplified Practice Recommendation R219-46 on Automatic Regulating Valves, issued by the National Bureau of Standards.

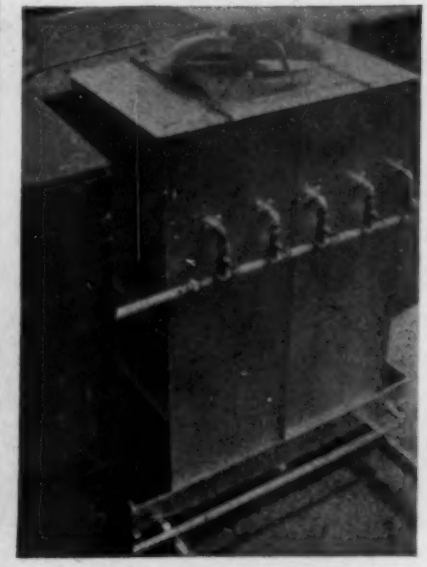
Mechanical Process for Increasing Strength of Metals

No. 6572—"Rigidized Metal," a product of an exclusive design-strengthening and texturizing process applicable to both ferrous and nonferrous sheet and strip is described in a new bulletin recently issued by Rigid-Tex Corp., 658 Ohio St., Buffalo 3, N. Y. According to the manufacturer, applications of this metal fall into three broad categories: (1) For increased mechanical values in flat sheets and structures, (2) For structural values combined with decorative values, and (3) Decorative values, particularly as connected with glare prevention and low maintenance. Copies of the bulletin may be obtained directly from the manufacturer by forwarding requests on company letterheads.

Nickel Steel Tubing

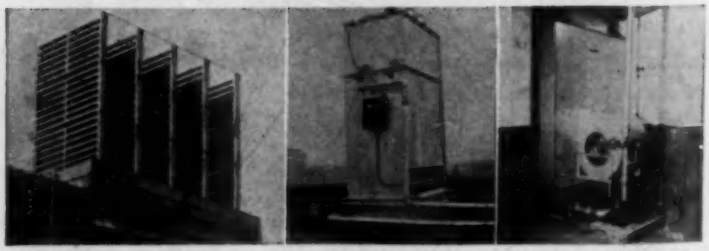
No. 6573—Mechanical working characteristics, heat treating behavior, and weldability of the newly developed 9 per cent nickel steel tubing, offered by the

TRAY COOLING TOWERS



COOLING TOWER ABOVE—40 Tons Refrigeration Capacity. 120 GPM. Induced Draft—Outdoor Unit.

SAVE 98% of CONDENSER WATER COSTS wasted thru REFRIGERATION and AIR CONDITIONING PLANTS



ATMOSPHERIC UNIT WORCESTER, MASS.

INDUCED DRAFT COOLING TOWER, PHILA., PA.

INDOOR COOLING TOWER, BROOKLINE, MASS.

TRAY COOLING TOWERS *offer*

★ ALL STEEL CONSTRUCTION
★ PACKAGE UNITS—REQUIRE LESS SPACE
★ OPEN DISTRIBUTOR HEADER — NO NOZZLES requires less horsepower for recirculating pumps.
★ INDOOR and OUTDOOR UNITS

Send for BULLETIN 46

Some open territory for factory representatives

NEW ENGLAND COOLING TOWER CO. 89 Broad Street BOSTON 10, MASS.